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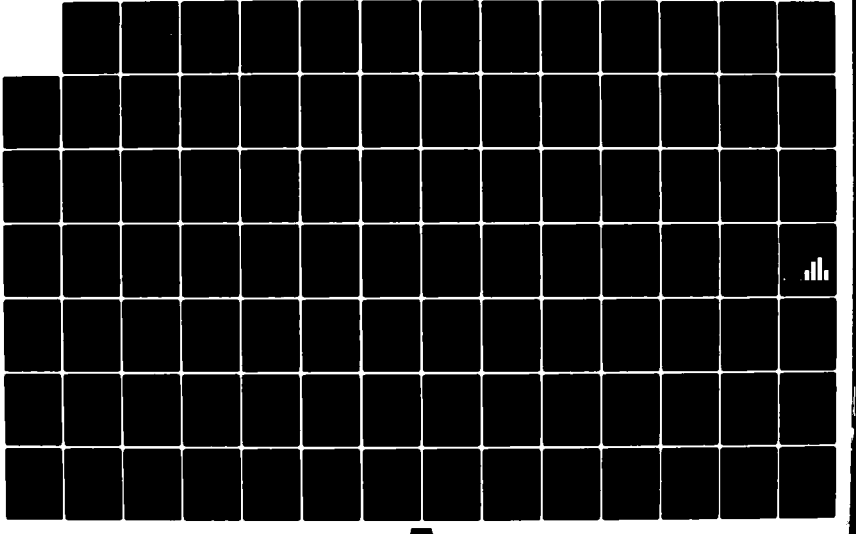

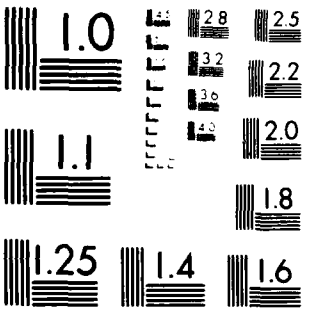

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ECONOMIC INFLUENCES ON RE-ENLISTMENT
The Draft Era

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Phase I Report

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CHAPTER 1

INTRODUCTION

A. The Problem

The Navy, along with the other armed services, confronts a continuing personnel problem. In simple terms, the problem is how to attract and retain qualified personnel, especially those with skills and experience valued highly in the civilian labor market. From a Navy perspective, the problem is manifest in recent and projected shortages of such ratings as aviation fire control technicians, signalmen, and electronic warfare technicians.

Prior to the advent of the All Volunteer Force (AVF), the services could satisfy most of their manpower requirements through conscription. Even then, however, there were persistent problems in retaining skilled personnel, since extended service was largely a voluntary decision in times of peace.

The AVF has accentuated this retention problem in several ways. To begin with, fewer young men are ever confronted with a potential enlistment decision, since military service is now voluntary. As a result, many young men who would have chosen Naval service in a draft era -- and might have stayed for extended duty -- are simply never exposed to the Navy. Moreover, those young men who now choose to enlist are more likely to be sensitive to economic influences. Limited civilian job prospects are often a catalyst for enlistment. So, too, are improved civilian job prospects more often likely to deter retention. In other words, the AVF has given greater scope to economic factors.

The AVF has also generated more emphasis on career goals and training. To recruit personnel, the Navy must tailor training and assignments more specifically to the desires of potential enlistees. As a result, enlistees are in a better position to exploit the training opportunities the Navy provides. As training and experience progress, the enlistee's value in his chosen field of expertise grows.

The skill requirements of Naval service have themselves increased. As a consequence, the Navy is compelled to compete for an even more sophisticated pool of potential personnel. This will become increasingly difficult as the total supply of eighteen-year olds diminishes in the coming years.

1. Alternative Responses

The Navy is, of course, acutely aware of these intensified personnel problems and has, along with the other services, explored a variety of policy responses. The most significant response has been a general upgrading of pay scales. In the last ten years, the basic pay of Navy enlistees has increased 300 percent. During the same period average civilian wages have risen 116 percent and consumer prices have risen 140 percent. Hence, Navy personnel have enjoyed a substantial increase in relative and real (inflation-adjusted) pay. These gains have encouraged enlistments and helped stem attrition.

In addition to across-the-board pay increases, the Navy has also implemented targeted monetary incentives. Re-enlistment bonuses are offered to discourage attrition among experienced personnel. By varying their value, the bonuses can be used to encourage extended service of personnel in skill-shortage areas. This option has been used in the past to encourage re-enlistment of nuclear personnel, with bonuses of up to $20,000.

Besides seeking to stem attritions of skilled personnel, the Navy has made a limited effort to enlist individuals having the desired skills. Through lateral entry, the Navy could conceivably fill skill gaps as they emerge. In this way, the Navy would be trying to resolve skill shortages by both detering attrition (e.g., via re-enlistment bonuses) and bringing in needed skills (e.g., lateral entry).

Finally, there is an increased emphasis on in-service training. The Navy has come to realize that intensive and extended training to enlisted personnel may be required to fill potential skill gaps. As noted above, this approach is risky, since it also implies increased market value for enlisted personnel. At a minimum, such an approach may require more careful targetting on enlisted personnel with higher probabilities of long-term retention.

2. What Works?

It seems reasonable to assume that these various policy responses, if pursued far enough, could solve any skill shortage problem. That is to say, the provision of unlimited pay, bonuses, lateral entry incentives, and training could presumably induce an adequate supply of skilled personnel. There are, however, two serious obstacles to the notion of simply "throwing money at the problem" until it is solved. First, Congress is not about to give the Navy a blank check. Second, even if more money were available, the question of efficiency would still be relevant. The ultimate objective of good personnel policy is not simply to solve a skill-shortage problem, but to do so in the most cost-effective way. This requires finding the optimal combination of incentives and programs that will yield the desired manpower profile.

At present, relatively little information is available for developing optimal incentive strategies. Personnel policy in this area appears to have evolved in a largely ad hoc manner. In part, this reflects the vagaries of Congressional decision-making and related budget constraints. It also reflects, however, an honest lack of knowledge about the impact or potential of specific policy initiatives. There is no consensus, for example, about how many additional (re)enlistments are induced by an increase in basic pay. Nor is there an established conclusion about the impact of re-enlistment bonuses on skill shortages.

The lack of knowledge about what policies work best (for which groups and in what contexts) does not reflect a lack of research interest. On the contrary, the Navy has taken a lead role in developing and supporting research on manpower dynamics. There are many good manpower models now available and some useful empirical results as well.

Perhaps the most serious constraint on manpower research has been the limited nature of available data. Current statistics on the number and characteristics of enlistees are readily available. So, too, are data on re-enlistment decisions. What is typically missing is information about the civilian opportunities and experiences of Navy personnel. Such information is needed to determine the potential supply of enlistees, the demand for skills of enlisted personnel, and the factors influencing the flow of individuals between Navy and civilian life.

B. Nature of the Study

This study represents an attempt to improve the information base for these basic manpower concerns. The study is unique in two key dimensions. First, the data base used provides detailed longitudinal information on the employment experiences of both Navy and civilian personnel. With these data it is possible to observe the pre-enlistment job experiences of enlistees,

the post-attrition jobs of veterans, and the earnings profiles of comparable individuals who chose not to enlist.

The second unique feature of this study is that it will provide a comparative analysis of AVF and draft-era manpower patterns. It cannot be assumed that all behavioral patterns since 1972 are uniquely associated with the volunteer force. On the contrary, only by contrasting AVF manpower patterns with earlier, draft-era patterns can we identify the salient effects of the AVF concept.

Potential Uses

When completed, this study will directly enhance the information base needed for strategic manpower planning. More specifically, the data and analyses generated during the course of this study will provide:

- a comparative perspective on all-volunteer and draft-era manpower patterns
- an improved basis for predicting general manpower and specific skill shortages
- an assessment of the relative importance of economic variables in (re)enlistment decisions
- an improved basis for assessing the cost efficacy of alternative strategies for altering manpower flows.

C. The Data Base

Because of the central role that new data plays in this study, the data base used should be described. Two major data files provide the empirical support for this study.

1. LEED Data

The core data base is the Social Security Administration's Longitudinal Employer-Employee (LEED) file. The LEED is a continuous, longitudinal sample

of 1 percent of all workers covered by Social Security legislation. Quarterly earnings and employment data are available for each individual in jobs covered by Social Security (over 90 percent of all private-sector jobs, plus military service and half of non-federal employment). In Phase I of the study, fifteen years of this file (1957-1971) are being utilized. The PIER file now includes longitudinal records for over 15,000 men who were on active Navy duty at any time during the observation period. This sample is statistically representative (random) of 1.5 million Navy personnel.

Update files through 1978 for this and additional samples are now being developed. The size and longitudinal characteristics of the LEED file enable one to track the detailed earnings and employment histories of select groups of veterans for a period of over twenty years, including periods of compulsory service (both pre and during the Vietnam War) and the AVF.

It may be noted that earnings covered by Social Security are taxable only up to a specified limit. In 1982, for example, only the first $32,400 of covered earnings are taxable. Social Security receives no information on earnings above that ceiling received from any single employer. Hence, the actual level of annual earnings for some high-earning individuals is unknown. This problem affects relatively few workers, however.* Moreover, Social Security records provide a mechanism for estimating the actual earnings of these individuals. Because Social Security payroll reports were filed quarterly until 1978, it has been possible to determine when a high-income individual "hit" the Social Security ceiling. The Social Security Administration itself uses this quarterly information to estimate annual earnings for such

*The ceiling was reached by approximately 20 percent of the total male sample during the period 1957-1971.

persons. These estimates are generally thought to be broadly reliable. The data file maintained for this study includes both the estimates of the Social Security Administration and the underlying quarterly earnings data.

Active personnel, reservists, and veterans may be identified in the LEED file by a unique military employer code. Personal characteristics such as race and age are identified, as well as quarterly employment information of each employer covered by Social Security. In particular, the (four-digit SIC) industry code, the (five-digit SSA) geographical location code, and (SSA) firm size code is indicated for each employer. Reported earnings for each employer up to the maximum taxable ceiling are given. A summary description of a single record is provided on the following page.

Length of military service since 1957 can be determined (on a quarterly basis) by observing how long the employer code of the military appears as an individual's employer. The length of military service may also be computed for active duty personnel, based upon their basic pay according to the pay scale for any particular year. In this manner, military service prior to 1957 for individuals on active duty from 1957-78 is identifiable.

In addition, the distinction between enlisted personnel and officers can be identified by observing the reported earnings for each individual during the quarter of entry into military service. In-service earnings also provide a mechanism for distinguishing personnel of various ranks.

The great advantage of the LEED file is its longitudinal micro character. It allows one to observe not only a person's entire Navy career but also the nature and extent of civilian employment before and after Naval service. Hence, one can determine how much money veterans earn in civilian jobs and infer therefrom the probable influence of economic forces on re-enlistment decisions.

LEED File: Data Elements

Fixed Portion: (one for each worker)

	Subject
1	Account Number
2	Sex
3	Race
4	Year of Birth
5	Total estimated wages for each year
6	Number of Employers in each year

Variable Portion: (one for each employer)

7	Year of data
8	Employer Number
9	Geographic Code
10	Industry Code
11	Schedule
12	Coverage
13	Employer Size
14	Wage Item
15	Annual Wages
16	First Quarter Wages
17	Second Quarter Wages
18	Third Quarter Wages
19	Fourth Quarter Wages
20	Estimated Wages

2. Navy Records

While the LEED file yields continuous longitudinal data for a large sample of individuals, it lacks individual specific information common to survey data. Most notably, it omits occupational, educational, and other socio-economic data. In addition, the LEED contains no information on the specific experiences of Navy personnel while in service. To overcome these problems, a second source of data is being used in this study. Master personnel files maintained by the Defense Manpower Data Center (DMDC) provide that source. For individuals who enlisted in the Navy between 1973 and 1975, the following kinds of data are being extracted from DMDC files:

- o Occupational speciality, at various career junctions (e.g., entry and exit)
- o Marital status
- o Number of dependents
- o Educational attainment
- o Achievement level (e.g., AFQT score)
- o Reason(s) for discharge
- o Length of initial and subsequent enlistments

The data extracted from DMDC files is being merged with the LEED file, thus creating a file that is both longitudinal and descriptively rich.

D. Two Phases

The present study is being conducted in two phases. The first phase focuses on the draft era exclusively, and uses only basic demographic and economic data from the LEED file. The primary purpose of Phase I is to develop basic models and methodology, while providing a comparative basis for evaluating the uniqueness of AVF manpower patterns.

Phase II of the study focuses on the AVF era and expands the range of information on individual enlistees. In Phase II, individuals who enlisted between 1973 and 1975 are the primary object of concern. As in Phase I, the LEED file is being used to extract the pre- and post-service civilian job experience of these enlistees. In addition, master Navy personnel files are being used to provide much more complete demographic profiles and summaries of in-service experience. These additional data make it possible to assess more closely the relative effects of economic variables and to study selected occupational groups more intensively.

The present report refers to Phase I only. Phase II is now underway and is scheduled for completion in the summer of 1983.

E. Outline of Report

Given the limitations of Phase I data, this report is of more interest from historical and methodological perspectives than from a current policy view. The policy implications of this study will be known only after both phases of the study are complete.

Chapter 2 surveys the more salient models of (re)enlistment behavior. The purpose of this survey is to highlight important features of alternative models and alternative methodological choices. Readers familiar with the literature on personnel retention or with a primary interest in empirical observations may prefer to skip over chapter 2.

Chapter 3 is descriptive. It depicts the pre-enlistment job experiences of draft-era enlistees as well as the post-attrition experiences of veterans. In chapter 3 the correlations between job experiences and Navy service are also examined. These correlations provide the basis for some later hypotheses.

In chapter 4 the focus is on the specific influence of civilian wage opportunities on re-enlistment decisions. Chapter 4 is the most analytical,

and includes a discussion of the techniques for estimating opportunity wages as well as for assessing their unique impact on re-enlistment.

Given the two-phase structure of this study, all empirical findings reported herein should be regarded as preliminary.

CHAPTER 2

RE-ENLISTMENT MODELS

1. Retention Issue

Since the inception of the AVF in July 1972, defense manpower officials have relied mainly on monetary incentives for meeting recruiting and re-enlistment goals. The particular mechanisms utilized include across the board pay increases, allowance increases, regular enlistment and re-enlistment bonuses and more recently variable and selective re-enlistment bonuses. While the cost-effectiveness of these various programs has been debated, most researchers agree that the monetary payments have had a significant impact on maintaining a high quality force structure.* In particular, recruitment shortfalls, which characterized the AVF in the early years, have all but disappeared as real military wages have increased significantly over cyclical swings in the private sector.

Despite the Navy's apparent success in averting serious skill shortages, the relative role of economic forces in this achievement remains a debatable issue. There is a wide range of estimates on the responsiveness of personnel supply to specific monetary inducements. There is also a continuing controversy about the relative influence of monetary and nonmonetary factors on (re) enlistment decisions.

In this chapter, the major models used for assessing the role of economic influences on (re) enlistment are reviewed. This review is then followed by a brief discussion of unresolved retention issues.

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*A recent G.A.O. Report (1982) surveys many of these research studies. Even though the report fails to distinguish between the quality of studies, interested readers will find the extensive bibliography helpful.

A. Econometric Retention Models

Since FY1980 Enlisted Separation Questionnaires (ESQ) have been given to all persons leaving the Navy and a similar questionnaire is now administered to personnel who re-enlist. Under the direction of behavioral psychologists from the Navy Personnel Research and Development Center (NPRDC), these questionnaires have been designed to identify the major influences on the re-enlistment decision. Currently, low military pay, family separation, geographic instability, petty regulations, and lack of recognition for doing a good job rank as the major problems in the retention of enlisted personnel.

While this information is important to document problem areas of retention, it is not in a quantifiable form useful for empirical testing of hypotheses related to the re-enlistment decision.* For example, all we know about geographic instability is that it is ranked "third" on the list of causal factors of the decision to leave the Navy for second and third term enlistees.** However, data are not collected on the times these personnel actually moved during their last enlistment period. If such data were available, one could estimate empirically the effect such moves have had on retention behavior.

Econometric models have been developed to complement and sometimes replace simple personnel surveys. Early models were developed for the President's Commission for an All Volunteer Armed Forces (the Gates Commission) and were among the first studies to generate estimates of the anticipated personnel supply response to policy variables. More recently, these models have been improved to generate supply responses for special ratings categories and by years of service (YOS) cells.***

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*For a recent behavioral study using quantifiable data, see Hom (1981).

**The ranking of such factors is published quarterly by the Retention Office of the Chief of Naval Operations (OP136).

***Warner 1979-b.

While these econometric models provide important insights into the retention problem, they by no means reflect the final generation of models capable of explaining and forecasting retention with a high degree of accuracy. First, important psychological factors which may be subject to policy alternatives are usually not included. Secondly, the economic variables included are subject to large misspecification errors and resulting parameter estimates may be biased.* Finally, improvements in the statistical techniques of the econometric models are continually being made as additional resources become available for research in this area.

Since the importance of econometric models appears to be growing within the defense manpower policy arena, it may prove instructive to explain first the economic theory underlying these models and then to describe the transition of the modeling improvements made since the late 1970's.

1. Choice Behavior and Retention Models

The theory of individual choice behavior is based upon the postulate that individuals having full information act rationally by choosing to reenlist if the pecuniary returns, net of costs, outweight their distaste for military as compared with civilian life.

For example, at a career juncture the enlistee is assumed to have an expectation of his civilian wage and employment opportunities if he were to leave the Navy. These expectations would be based upon his acquired stock of human capital (prior education, work experience, and civilian and military training) and by the actual post-Navy civilian experiences of fellow former enlistees with similar backgrounds. At the same time the enlistee has expectations of typical promotion patterns within his relevant rating categories.

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*In addition, parameter estimates will not have minimum variable as being statistically insignificant. For a further discussion, see Daula, et.al. (1982).

These expectations along with probable pay scale raises (a function of prior pay increases) enable him to derive a monetary value of future military service.

It is postulated that the rational enlistee calculates the monetary value of these two different streams of earnings at the point of a re-enlistment decision.* In a model whereby enlistees are "taste neutral" (i.e., have no preferance, ceteris paribus, for military or civilian life), theory predicts that one will re-enlist if the expected military returns net of civilian returns are positive. In the language of the model builders, one may speak of re-enlisting as long as the cost of leaving is positive -- where the cost is measured as the net of military returns less civilian returns.**

The attractiveness of such models lies in their simplicity. Retention forecasts by length of service and selected ratings categories can be generated, based upon predictions of two wage streams. The problem of course lies in the reliability of these forecasts, as well as the omission of non-pecuniary factors that may be related to the monetary factors and/or taste factor.

2. Empirical Specifications

The Early Cost of Leaving Models. The simple theory described above has been reflected in all econometric retention models since the Gates Commission Report in 1970.*** Only improvements in data availability and statistical

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*More precisely, one must calculate the "present value" of each earnings stream discounted by one's individual rate of time preferance. The higher this discount factor the less valuable are future earnings, thus the lower the present value of the earnings stream. For a detailed discussion of recent attempts for estimating discount rates of enlistees, see: Clyke et. al. (1982).

**In a more complex model which specifies a military taste factor, the cost of leaving net of the military distaste factor must be positive -- where the distaste factor is positive if one prefers civilian to military life and negative if one prefers military to civilian life.

***The four basic retention models developed for the Gates Commission Report are: Grubert and Weiher (1970), McCulloch (1970), Nelson (1970), and Wilburn (1970).

techniques separate current from earlier retention models. Basically, all current models may be said to have their roots in a cost of leaving model developed by Glenn Gotz and John McCall in a Rand report done for Air Force Officers (1980). The authors used Bureau of Census aggregate data to compute civilian opportunity wages and developed a measure of Regular Military Compensation (i.e., RMC, which is the value of Basic Monthly Pay, Basic Allowance for Subsistence and Quarters, and an imputed value of the tax advantage of the non-reported allowances and non-state reported basic pay) using USAF data. The military stream of earnings was weighted by observed promotion and separation probabilities, and a policy variable measured as the (maximum) net-present value of military less civilian earnings was calculated for various pay grade and length-of-service cells. A dynamic programming model specifying a Maximum Liklihood Estimation (MLE) technique was then estimated to predict the retention behavior of Air Force officers. Since then, this construct has been used to develop similar models by researchers at the Naval Personnel, Research, and Development Center (NPRDC), the Congressional Budget Office (CBO), and at the Center for Naval Analysis (CNA). Currently, the Navy has relied most heavily on the CNA version of the cost of leaving models. For this reason, we will describe them in detail. The reader is referred to Table 2.1 for a brief summary of the major characteristics of the retention models that were based upon the Gotz-McCall formulation.

The CNA Cost of Leaving Models. The most widely used form of the CNA model is often referred to as the "Annualized Cost of Leaving" -- or ACOL model. The theoretical model specification is given as:

$$(2.1)\quad C_{t,n} = \left[\sum_{j=t}^{n} \frac{M_j}{(1+r)^{j-t}} + \frac{\bar{W}_n + \bar{R}_n}{(1+r)^{n-t}} \right] - (W_t + R_t); \text{ where:}$$

$C_{t,n}$ = net present value of pecuniary and non-pecuniary returns of staying in the military until time "n" as compared with leaving in the current period "t".

M_j = monetary returns to military service from period "t" through "n".

$\bar{W}_n$ = lump-sum payment of the present value (in period "n") of the expected post-service civilian wages realized by those staying in the military until "n".

$\bar{R}_n$ = lump-sum payment of the present value (in period "n") of the expected retirement benefits realized by those staying in the military until "n".

W_t = present value in year "t" of the expected civilian wages realized by those leaving the military in year "t".

R_t = present value in year "t" of the expected civilian retirement payments for those leaving the military in year "t".

r = individual rate of time preference (i.e. the "discount rate").

The first term in the bracket of (2.1), is the monetary value of expected military pay (M_j), discounted over time. The pay measure should include not only monthly basic pay, but all "fringe" benefits such as allowances, special pay, bonuses, commissary subsidies, state tax advantages, etc., which are realized by those in the services. In reality, many of the fringe payments are difficult to quantify and estimates for RMC, much like those done by Gotz and McCall, are often specified in the ACOL framework.

The second term in the bracket, $\bar{R}_n + \bar{W}_n$, is a measure of the returns realized once one stays until "n". Often "n" is defined as the year of retirement (YOS=20) at which time the retirement rights become vested. An expected stream of retirement pay is calculated and discounted to the last year

Table I

SELECTED MILITARY RETENTION MODELS

MODEL	NAME	DEPENDENT VARIABLE	INDEPENDENT VARIABLES	MODEL SPECIFICATION	DATA SOURCE	SPECIAL FEATURES AND USES
1	RAND[1]	-Maximum Net-Present value of Military less Civilian Earnings for Pay Grade/YOS CELLS	-Military Earnings (RMC +Bonus+Severance) -Pay Grade -Civilian Earnings (CPS data) -Involuntary Separation/ Retirement Pay -Probabilities of Promotion and involuntary separation	-Maximum likelihood Function on pooled sample across Y.O.S. and pay grad	Census Bureau, CPS data; USAF internal data	-Dynamic programming model based upon marginal analysis of maximization of N.D.P.V. of life cycle earnings -Aggregate data into YOS/ paygrade cells -Explains decision to stay in service for full career -Used for USAF officers -10% discount rate for all
2	NPRDC[2]	-Average retention probability by pay grade and YOS cells (1-8; 9-19, 20-31 YOS)	-Military Earnings (RMC) for cells Incentive Pay) -Pay Grade -Civilian Earnings (median earnings of age/schooling cohorts based on CNA estimates [Warner (1978)] with zero growth rate. -Involuntary Separation/ Retirement Pay -Probabilities of Involuntary separation and promotion -YOS	-Weighted least squares logistic function of average retention probabilities by YOS/ pay grade cells.	Navy Personnel Planning Data Base (FY76-77) and Social Security Longi-tundinal Earnings Data from [ ].	-Aggregate data into YOS/ paygrade cells -life-cycle earnings framework -Add YOS interaction (with time) variable to capture decrease in military distaste factor in later YOS groups -Promotion probabilities determined over 2 year average of number of promotions/personnel at end of year -explains decision to stay in service for full career -10% discount rate for all

Table 1 cont'd

MODEL	NAME	DEPENDENT VARIABLE	INDEPENDENT VARIABLES	MODEL SPECIFICATION	DATA SOURCE	SPECIAL FEATURES AND USES
3	CNA:I[3]	Average retention probability for YOS groups (4-9 + 10-19 YOS)	-Military Earnings (RMC) for YOS cells -Pay Grade -Civilian Earnings (CNA age/ schooling median earnings with 1.5% growth rate	-Logistic Function of average retention probabilities by YOS cells.	-Defense Manpower Data Center and Social Security Longitudinal Earnings Data File [ ]	-Aggregate data into YOS cells -Life cycle earnings framework -YOS interaction variable -Promotion probabilities based on one year average of number of promotions/ personnel at beginning of year. -assumed zero probability of involuntary separations/ retirement -ran model on pooled sample across two YOS categories and on stratified groups -explains decision to stay in military for full career -used for enlisted personnel in all branches -10% discount rate for all -Military enlisted personnel
4	CNA:II[4]	Average Retention probability for YOS and Pay Grade Cells for two YOS groups (4-9 and 10-16)	-Military Earnings (RMC) for YOS cells with retirement pay evaluated over differing time horizons. -Pay Grade -Civilian Earnings (CNA estimates with +1.5% growth rate.	-Logistic Function of Average Retention probability by YOS and Pay Grade Cells	-Defense Manpower Data Center and Social Security Longitudinal Earnings Data File [ ]	-aggregate data by YOS/Pay Grade cells -YOS interaction variable -one year promotion probabilities as computed in CNA:I -Zero probability of involuntary separations/ retirement. -estiamtes PDV of retirement pay over varying time horizons (depending on various retirement plans)

Table 1 cont'd

MODEL	NAME	DEPENDENT VARIABLE	INDEPENDENT VARIABLES	MODEL SPECIFICATION	DATA SOURCE	SPECIAL FEATURES AND USES
4	CNA:II (cont'd)					-explains decision to stay in military for full career. -Military enlisted personnel
5	CBO[5]	-Average Retention Probability for YOS Cells	-Military Earnings (includes RMC and Early Withdrawal/ Bonus and Retirement annuities) -Civilian Earnings (Uses CPS age-earnings estimates and retirement) -Probabilities of continuation by YOS -Ratio of Present Value of Military to Civilian earnings for future 6 years. -Ratio of Present Value of Military to Civilian earnings for 7 years to retirement	-Logistic Function of Average Retention Probability by YOS	-CPS median earnings data and Defense Manpower Data Center, Rand 1976 Survey for reenlistment probabilities by YOS.	-Measures military-civilian pay variable as a ratio rather than as a net difference -Two planning decision hiring possibilities (i.e., short vs. long-term planning) -Weights military, civilian and retirement pay by appropriate continuation probabilities -Used for Department of Defense enlisted personnel
6	USAF	-Average Retention Probability for YOS and Pay Grade	-Military Earnings (RMC and Early Withdrawal/Bonus and Retirement annuities) -Civilian Earnings (use Warner [ ] data plus 1.5% real growth rate -Ratio of Present Value of Military to Civilian earnings (measured over entire military career) -Probabilities of reenlistment at each 4 yr. period and probability of continuation for all other years	-Logistic Function of Average Retention Rate Probability by YOS and Pay Grade	-Social Security Administration Longitudinal Earnings Data Compiled by [ ] USAF data for probabilities	-Use both continuation and retention rate probabilities on future military and civilian earnings -Life-cycle approach to evaluation of earnings -Measures Military-Civilian Pay differential as ratio -Used for USAF enlisted personnel

Source: "Comparative Analysis of Enlisted Retirement Behavorial Models," Mark D. Chipman, Naval Personnel Research and Development Center, Technical Note 80-1, November 1979.

of military service (n). Then this lump-sum ($\overline{R}_n$) is discounted to the current period (t).*

In addition, this term includes an expected stream of veterans earnings in the civilian sector ($\overline{W}_n$) realized after retirement from the military. The stream of civilian wages is discounted to the last year of military service, and this lump-sum is then discounted to the current period (t).

The last term in the ACOL model represents the opportunity costs foregone if one stays in the military from time "t" through "n". The costs are wage (W_t) and retirement (R_t) returns discounted to the current year "t". Whereas early retention models used average wages (sometimes for age, sex, race, and marital status cohorts) published in the Current Population Surveys by the Department of Commerce, ACOL uses estimated earnings derived from Social Security Administration longitudinal records. While such efforts have improved the specification of the major policy variable in the CNA's re-enlistment model, great uncertainty as to long run pattern of wages remain.

In the estimation of the present value of both military and civilian returns (i.e., wages and retirement/pension payments) in the ACOL model, a discount rate (r) must be specified. Based upon other research done at CNA, an initial 20% real discount rate is specified for those making their initial re-enlistment decision. This rate falls over more senior personnel until a 10% rate is assumed for those reaching twenty years of service.**

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*It may be noted that the discounted value of post-service civilian retirement plans (both private pensions and Social Security) should also be included in this measure. It does not appear, however, that such calculations have been made in the expanded retirement choice versions of ACOL.

**An early study by Heckman (1976), estimated a real discount rate (i.e., the nominal discount rate adjusted for inflation) to be on the order of 18-20%. More recently, Clyke, et al. (1982) have derived an 18.5% real rate for first term enlisted personnel.

The improvements in the theoretical construction of this early ACOL model have mainly taken place in the form of modeling the unobserved military taste factor described earlier. As such, the first major improvement added is the discounted taste factor:

$$\sum_{j=t}^{n} \frac{\delta^{j}}{(1+r)^{j-t}}$$

As stated earlier, if δ is positive one prefers military to civilian worklife; if negative, one is said to have a "distaste" for military service, compared with civilian life. This may occur because of long sea duty tours, long work days, material resource shortages, etc. On the other hand, a positive taste for Naval service may reflect

- o job security
- o less competitive environment
- o sense of patriotism
- o sense of accomplishment.

Because taste was assumed to be given, it was treated as an exogenous variable -- although one subject to policy alterations.

To analyze whether one should <u>stay</u> in the military, from year "t" through "n", the appropriate calculation is first to determine if the net present value of the expected returns (i.e., returns less costs) are positive. In terms of the model specifications, this implies that $C_{t,n} > 0$, where:

$$(2.2) \qquad C_{t,n} = \left[\sum_{j=t}^{n} \frac{\delta_j}{(1+r)^{j-t}} + \sum_{j=t}^{n} \frac{M_j}{(1+r)^{j-t}} + \frac{\bar{R}_n + \bar{W}_n}{(1+r)^{n-t}} \right] - (R_t + W_t)$$

The expected returns are measured by the three terms in the first bracket and the relevant costs are measured by the foregone earnings in the second bracket.

Stated differently, if one subtracts the net military taste factor from the net-benefit measure, one would decide to stay if there is at least one time horizon over which cost of leaving exceed the (negative) present value of the taste factor. This may be written as:

$$(2.3) \qquad \left[\sum_{j=t}^{n} \frac{M_j}{(1+r)^{j-t}} + \frac{\bar{R}_n + \bar{W}_n}{(1+r)^{n-t}} - (R_t + W_t) \right] > (-) \left[\sum_{j=t}^{n} \frac{\delta_j}{(1+r)^{j-t}} \right]$$

If one were to divide (2.3) by

$$\sum_{j=t}^{n} \frac{1}{(1+r)^{j-t}}$$

the discount factor, one may speak of the annuity equivalent, $A_{t,n}$, of the cost of leaving variable, $C_{t,n}$. It is this form that the model derives its name ACOL, or the "annualized cost of leaving." *

In this form, (2.3) implies that an individual will stay only if there exists at least one future time horizon over which: $A_{t,n} > -\delta_j$. Thus, the

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*The ACOL model has been used for many different applications for studying the impact of pay increases on retention. See for example: Warner (1978), Warner (1979 - a and b), Warner and Simon (1979).

theory implies that each individual will compute the value of $A_{t,n}$ for each year remaining of his enlistment period and stays only if one of them -- the maximum value A_t, exceeds the military distaste factor. Leaving costs are only positive if $-A_t < \delta_j$ and negative if $-A_t > \delta_j$. Therefore A_t, the maximum ACOL value, is what separates leavers from stayers. Thus the retention rate is simply the proportion of individuals for whom $-A_t < \delta_j$:

$$(2.4) \quad R_t = \int_{-A_t}^{\infty} f_t(\delta)\, d\delta$$

If one assumed that δ_i is distributed normally with mean zero and constant variance, one can express the probability of re-enlistment (values from 0 to 1) as a logistic function A_t:

$$(2.5) \quad r_t = \frac{1}{1+e^{(-\alpha_t+\beta \cdot A_t)}}$$

This can be transformed by noting that:

$$1 - r_t = \frac{1+e^{-(\alpha_t+\beta A_t)}-1}{1+e^{-(\alpha_t+\beta A_t)}}, \text{ so that}$$

$$\frac{r_t}{1-r_t} = \frac{1}{1+e^{-(\alpha_t+\beta A_t)}} * \frac{1+e^{-(\alpha_{t,t}+\beta A_t)}}{1+e^{-(\alpha_{t,t}+\beta A_t)}}, \text{ or}$$

$$\frac{r_t}{1-r_t} = e^{(\alpha_t+\beta A_t)} \text{ and finally}$$

$$(2.6) \quad \log\left(\frac{r_t}{1-r_t}\right) = \alpha_t + \beta A_t$$

Stated in this form the re-enlistment rate is a linear (i.e., log-linear) function of both the net military taste factor (whose average value is captured in the intercept term) and the annualized cost of leaving A_t.

The latest version of the ACOL model differs from the earlier version by adding a transitory or random disturbance term to (2.6). This disturbance term treats both military and civilian earnings streams as uncertain and allows for non-monetary disturbances, such as poor duty station, long sea-shore relations, etc., to induce individuals to leave after a term even if one's maximum ACOL, A_t, exceeds the military distaste factor. As such, an individual's cost of leaving is expressed as a probabilistic or stochastic function and the decision to leave depends upon his perceived probability of leaving after each term of service. In this form the model is referred to as the Stochastic Cost of Leaving (SCOL) model. The cost of leaving is measured as the weighted average of the leaving costs, where the weights are the probabilities of completing a future term of service and then leaving.

Warner, using longitudinal data for the subsample of enlistees having made at least two re-enlistment decisions, uses a MLE technique to estimate two distribution parameters -- one for the taste factor of those eligible for first term re-enlistment and the other for the transitory disturbance factor. While his SCOL version represents a more theoretically appealing version of cost of leaving models, its complexity and noted application constraints have limited its applicability to the defense manpower policy community.* Currently, the Department of Defense as well as the Department of the Navy is using the ACOL model described above for its manpower force projections.

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*For a detailed discussion of the SCOL model's strengths and weaknesses, see Warner (1981).

Respecification of the Cost of Leaving Model. While one cannot argue the theoretical foundation of the ACOL model developed above, it may be useful nevertheless to respecify the model so as to highlight an implied assumption concerning civilian wage opportunities across Years of Service (YOS) cells.

To make matters as simple as possible, let us assume that one is only concerned with first term re-enlistment and (as found empirically) enlistees have real discount rates in excess of 20%. These two assumptions permit one to ignore, for all practical purposes, retirement pay since its discounted value is so low. To a lesser degree one could also ignore expected wages long after the enlistment period. Furthermore, let us assume "taste neutrality" on the part of enlistees, for adding taste would not change any of the conclusions but would only add to model complexity. In such a world the decision to re-enlist in period "t" would be represented as:

$$(2.7) \quad C_{t,n} = \beta^{j-t-1} \sum_{j=t+1}^{n} M_j - W_t, \quad \text{where}$$

$C_{t,n}$ = cost of leaving in period "t" rather than "n"

M_m = expected military returns in periods "j"

W_t = present value of expected civilian earnings if leave in period "t"

β = discount factor = (1/1+r).

Now one could also write the value of the cost of leaving in the next enlistment term as:

$$(2.8) \quad C_{t+1,n} = \beta^{j-t-2} \sum_{j=t+2}^{n} M_j - W_{t+1}$$

Subtracting (2.7) from (2.8) yields the change in the cost of leaving ($C_{t+1,n} - C_{t,n} = \Delta C$):

$$(2.9) \quad \Delta C = \left[-M_t - (W_{t+1} - W_t)\right]^*$$

It must be noted that the relatively constant growth in expected military pay, especially a rate of growth less than the discount rate, will cause the value of ACOL at successive time periods to decline. That is, ΔC in (2.9) is expected to decrease over later YOS because of the relatively slow growth in military pay. As seen in (2.9), greater values of M_t will slow the change in ACOL, and therefore lessen the decrease in the cost of leaving the military. The obvious result is greater military pay will enhance retention.

More importantly (2.9) is useful in emphasizing the key role played by different civilian wage opportunities correlated with increased YOS cells. If increased YOS results in enhanced skills (which are transferable to the civlian sectors as emphasized in recent recruiting efforts) individuals should realize a higher present value of earnings with additional years of Navy service, which reduces the cost of leaving Navy service substantially. In terms of (2.9), if $W_{t+1} > W_t$ the change in ACOL is reduced toward zero suggesting that the more skills acquired in the Navy, the sooner one faces a negative (or zero) cost of leaving and retention rates fall.

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*A zero discount rate is assumed in (2.9) for simplicity. If one were to include a positive rate, say 20%, the value of the change in military earnings would increase. This may be shown most easily by noting the change over the first three years following (t+1) is given as: M_{t+2} [(1/1.2)+1.0] + $M_{t+3} \cdot 1/1.2$ [-1/1.2+1] + $M_{t+4} \cdot 1/1.2^2$ [1/1.2-1] = +.167 M_{t+2} + .139 M_{t+3} +.115 M_{t+4}. This impact quickly depreciates, however, as the fraction of the future wage added to M_t approaches zero.

The potential for increasing one's civilian wage opportunities is depicted in Figure 2.1. If one leaves the Navy in period t, one can expect to start out on the wage profile labeled C^1 at point "A". By the time of the next re-enlistment period t+2, this individual would expect to be at point "B" on his original wage profile.

However, if additional Navy service is able to place the individual on a new and higher wage profile -- say that depicted as C^2 -- then one can earn a level of wages indicated by point "C" which is clearly superior to that in the same time period along the C^1 wage profile. Only if individuals can realize such wage growth is it possible for the present value of civilian wages to increase over time (i.e., $W_{t+1} > W_t$).

The reason for respecifying the ACOL model format therefore becomes clear. The major impediment to maintaining optimal retention rates in selective ratings is due to the wage pressures exerted in the private sector. Military wage increases must be greater than those occuring in the private sector, both independently and as a function of accumulating Navy service. As such, the emphasis of a retention model such as (2.9) is upon estimating the civilian wage opportunities facing varying YOS cells across skill shortage ratings.

This issue has always been recognized by those using ACOL, but civilian longitudinal data limitations have caused researchers to give this topic only passing reference.* A major objective of this study is to indicate that short-term growth rates in civilian earnings are substantial as is the variability about this growth rate across the various civilian sectors which employ Navy veterans. These matters are crucial to effective re-enlistment policies that must design selective re-enlistment bonuses for varying YOS cells across skill shortage ratings.

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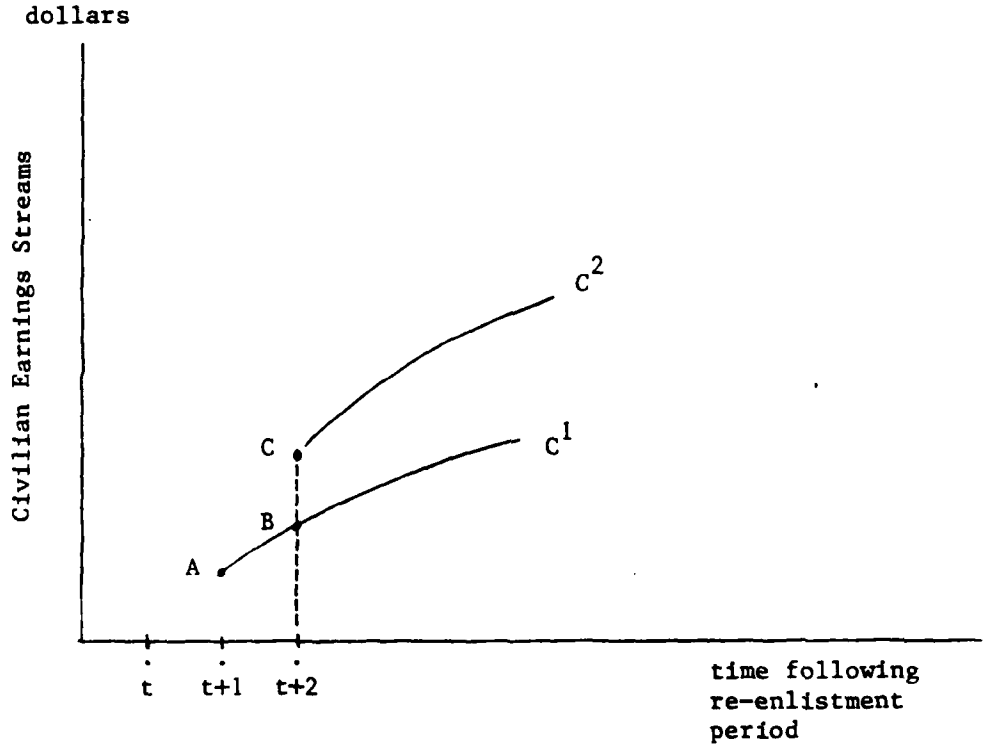
*For the latest example of such a position, see Warner (1981, p. 25).

Figure 2.1

HYPOTHETICAL CIVILIAN EARNINGS STREAMS
AND NAVY YOS



B . Unresolved Retention Modeling Issues

The discussion up to this point has summarized the major theoretical formulations of current retention models. While there is general agreement as to the theoretical underpinnings of various models, a significant disparity exists in the statistical methodology and measurement procedures followed. In particular, unresolved modeling issues include: proper estimation techniques, appropriate functional form, and accurate measurement of the behavioral variables. Each of these issues will be discussed separately and will provide the organizing principles for the modeling specification chosen for the retention models developed in this study.

1. Estimation Technique

The modeling of re-enlistment behavior may best be described as binary choice regression analysis. The major endogenous variable of the regression models is a dichotomous variable whose value is either one if a person re-enlists or zero if one leaves the service at some particular career juncture. In general, one may specify these major estimation techniques for analyzing such "qualitative response" variables: linear probability, probit and logit modeling techniques.

Linear Probability Model. The basic modeling technique used in some early studies of retention is the ordinary least squares (OLS) regression model. Econometric problems occur, however, when using the OLS technique because of the nature of the error terms generated. In particular, OLS analysis assumes among other things that the error terms are normally distributed with constant variance

and mean of zero (i.e., $N(0, \sigma^2)$). With a dichotomous dependent variable, however, the error term assumes a bimodal distribution with a variance $\sigma_i^2 = Y_i (1-Y_i)$. Violation of these two assumptions yields three potential major problems for modeling retention behavior.

First, while the parameter estimates are unbiased and consistent, they are inefficient -- i.e., they are not estimators with minimum variance. It may be noted that this problem is not that serious, for a generalized least squares (GLS) model can be constructed that weights both dependent and independent variables by the estimate of the error variance term to improve the efficiency of estimated parameters, especially in large sample sizes.

Second, it has been argued that an additional problem arises with regard to classical statistical testing (e.g., hypothesis testing that an estimated parameter is significantly different from zero with the standard normal t-test) in OLS qualitative choice models.* As reported in Warner [1978] however, an earlier study by Ladd (1966) found that the statistical tests in binary choice models are exact.

A final, and more serious problem with OLS estimation techniques is that the estimated value of the dependent variable may lie outside the bounded 0,1 range. Thus, even the GLS model estimators may not be efficient, especially for smaller samples.** As a result, some researchers have chosen

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*See for example, Pindyck and Rubinfield (1976), p. 241.

**Pindyck and Rubinfield (op. cit., p. 241) argue that the GLS technique is seriously sensitive to errors of specification and since the estimated values of the dependent variable may still lie outside the 0,1 range, it is recommended that the OLS technique be used for linear probability models.

to use a constrained OLS technique that arbitrarily assigns a value close to to 0,1 boundaries for estimated values outside the range.

Probit Model A more complex estimation technique, probit analysis, has been used to address the problem of estimated values lying outside the 0,1 range in retention models. This technique transforms the variables in the retention model by a cumulative normal probability function, which constrains estimated values of the dependent variable to the 0,1 range. This function may be specified as:

$$P_i = F(Z_i) = \frac{1}{2\pi} \int_{-\infty}^{Z_i} e^{-s/2} \, ds, \text{ where:}$$

P_i = probability of retention constrained to the 0,1 interval

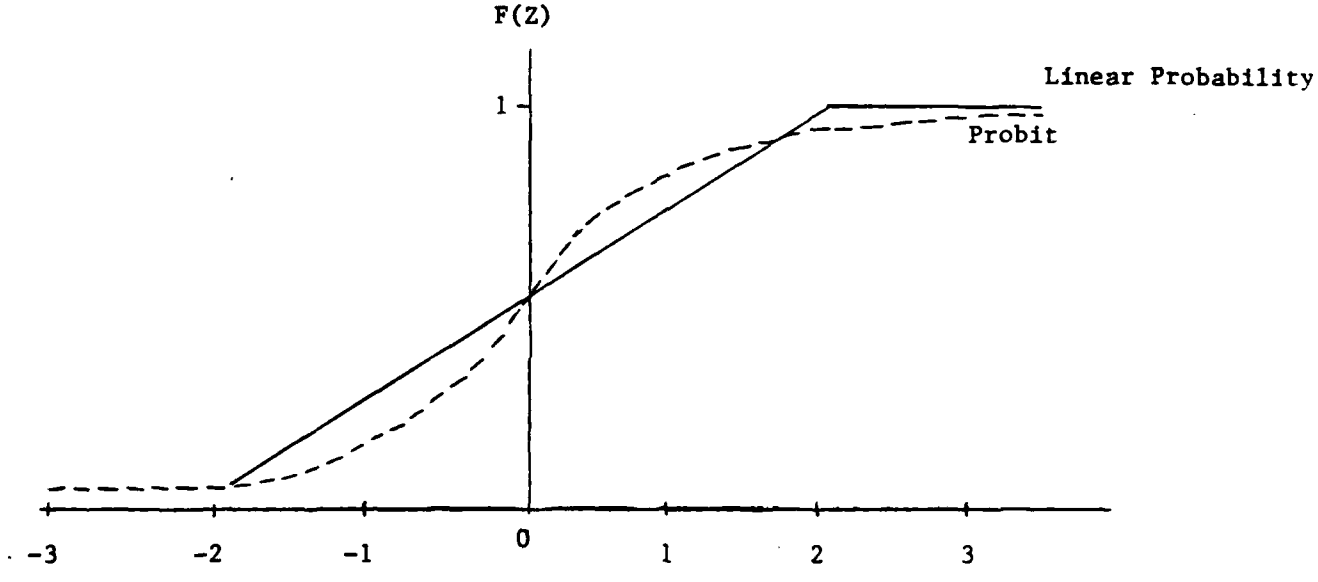
Z_i = linear function ($Z_i = \alpha + \beta X_i$) of individual attributes X_i, such as personal characteristics, schooling, work experience, etc.

In this model, the probability of retention is assumed to be directly related to an index Z_i, which measures the odds that an individual (i) will re-enlist. There is some critical value Z_i^*, such that if $Z_i \geq Z_i^*$ one will re-enlist. The cumulative normal function, along with a (constrained) linear probability model is shown graphically in Figure 2.2 The variable Z_i shown in Figure 2.2 is calculated as the inverse of the cumulative normal function above -- or $Z_i = F^{-1}(P_i) = \alpha + \beta X_i$.

As seen in Figure 2.2 the probability of retention in the probit model is not assumed to be constant for all Z as in the linear probability model. As such, the probit model assumes that an individual's probability of reenlisting will not be significantly affected by changes in individual

Figure 2.2

LINEAR PROBABILITY VS. PROBIT MODEL



attributes (viz. the relative military-civilian pay variable) in $Z_i = \alpha + \beta X_i$) for those with relatively low values of Z (i.e., not likely to reenlist) or high values of Z (i.e., most likely to reenlist). It is this non-linear reenlistment behavior that makes probit (or logit) models intuitively appealing as compared with the linear probability models discussed above.

The probit model is not without its own faults, however. As noted by Nelson (1970) in his study for the Gates Commission, the greatest expected response to a change in individual attributes on retention behavior occurs near the inflection point of F(Z) -- or at 0.5 in Figure 2.2. The problem with this outcome is that , the inflection point is not known and must be estimated for the sample by a curve-fitting exercise on the Z_i variable (i.e., $Z_i = \alpha + \beta X_i$). Not only is such a procedure likely to result in an inappropriate inflection point estimation, but any inflection point that does exist may lie outside the range of the data.

Logit Model A third estimation technique used in binary choice retention models is the logit model, which differs from the probit technique in its transformation of the binary dependent variable by a cumulative logistic probability function to constrain its value to the 0,1 range. This function may be specified as:

$$P_i = F(Z_i) = \frac{1}{1+e^{-Z_i}} ,$$

where again Z_i is a linear function of individual attributes ($Z_i = \alpha + \beta X_i$). This function can be transformed further, as was done above

for the ACOL model, into:

$$Z_i = \log\ (P_i/1-P_i) = \alpha + \beta X_i.$$

This technique is generally preferred to the probit model in that it transforms the probability of retention from the 0,1 range to the prediction of the odds of re-enlisting over the range of the entire real line.*

Choice of Estimation Technique. Given the complex econometric techniques and intuitive appeal for explaining retention behavior with probit or logit models, it is small wonder that few econometricians currently use the linear probability model specification. While simplicity may be considered archaic in econometric modeling, a comparison of the properties of the various estimation techniques in the current literature on military attrition and retention suggests that the linear probability model yields results similar to those of the probit and logit models.

The first piece of evidence may be found in comparisons of the predictive ability of the three attrition models utilized by Warner (1978). While the more complex models did yield better predictive results, the differences were only in the order of from 1 to 4 percentage points.

In another work comparing the impact of re-enlistment bonuses on retention in the Navy, Kleinman and Shughart (1974) found a close similarity among the elasticity estimates between linear probability and logit models. In essence, it appears that there is no clear consensus as to the "best" estimation technique to use in modeling retention behavior for large samples. While the more complex models appear to yield slightly improved results, it is

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*See Pindyck and Rubenfield, op. cit., p. 249.

not clear that the additional benefits warrant the significant increase in additional computation costs (as high as 2½ hours of computer time for a Maximum Likelihood Estimation (MLE) technique used for the logit model on 30,000 observations by Warner [1978]).

2. Functional Form of Models

The second issue concerning the modeling of retention behavior is the appropriate functional form of the models. Most econometric retention models may be classified as two stage models which may be specified in a simultaneous equation system as:

$$(2.10) \quad \hat{W}_m = f(SP, E, M)$$

$$(2.11) \quad \hat{W}_c = g(SP, E, M)$$

$$(2.12) \quad \hat{R} = h(\hat{W}_m, \hat{W}_c, SP, E, M), \text{ where}$$

W_m = measure of expected future military wages at a particular juncture in one's military career.

W_c = measure of expected future civilian wages if one leave the military at a particular career juncture.

R = measure of retention probability

SP = measures of socio-psychological factors that affect wages and retention (e.g., personal characteristics, attitude towards the service, motivation, ability to handle stress, etc.)

E = measures of economic factors that affect wages and retention (e.g., length and type of work experience, specific training, etc.)

M = measures of military factors that affect wages and retention (e.g., rating, rate of promotion, etc.)

The system depicted in (2.10)-(2.12) can be solved if the number of exogenous and/or pre-determined variables excluded in the retention equation (2.12) are equal to (i.e., "exactly identified") or greater than (i.e., "over identified") the number of endogenous variables in (2.12) -- i.e., the two expected wage measures. As such, one need only identify certain variables -- such as the intention to re-enlist, relative taste for military life, number and age of dependents, etc. -- that affect re-enlistment but not wages to yield a unique solution for the simultaneous system of equations.

In practice, the first stage regressions (2.10) and (2.11) are estimated and the predicted values of the wage measures ($\hat{W}_m$ and $\hat{W}_c$) are used in the second stage retention equation (2.12).*

Since manpower economists are mainly interested in the impact of the expected wage variables on retention, one may argue that the specification of the econometric models described above include socio-psychological factors in the first stage regressions (2.10) and (2.11), which are omitted in the retention equation:

$$(2.13) \quad R = k\ (W_m,\ W_c).$$

This specification does not exclude completely the impact of socio-psychological factors on retention, as long as these factors were included in the first stage regressions. Thus the estimated impact of the expected wage factors in (2.13) on retention behavior is not "biased" when the socio-psychological factors are omitted in the reduced form model. However, if one is interested in the total explanatory power of the second stage model

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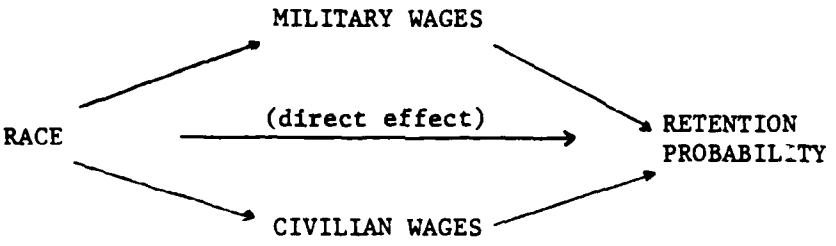
*As noted in Daula et.al. (1982), inconsistent estimators may result if one fails to control for the selection process of the two groups of observations across these two first stage regressions.

Figure 2.3

THE EFFECT OF RACE ON RETENTION



-- or if one is interested in estimating the total effect of the socio-psychological factors on retention -- then the complete retention model (2.12) should be specified.

As depicted in Figure 2.3, the total effect of these factors (e.g., race) is composed of the direct effect (i.e., the coefficient on the race variable when it is included in [2.12]) and the indirect effect, which is picked up by the estimated wage variable.*

3. Measurement of Behavioral Variables

The last issue regarding modeling of retention behavior is the choice researchers face in measuring the variables in the simultaneous equation system that explains re-enlistment behavior -- most notably the endogenous retention and wage variables.**

Retention Variable. The major issue regarding the measurement of the dependent retention variable, given an estimation technique, is whether to use grouped or individual specific data. For example, if one specifies the retention model in logistic

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*The size of the indirect effect of race cannot be measured in (2.12) since it, along with all the other effects of the other factors in (2.10) and (2.11) are included in the wage variables. One could, however, estimate the indirect effect of race on retention by specifying a retention model that includes race, without the wage variables (with which race has an indirect effect on retention). The coefficient of race in this model would be an estimate of the total effect of race on retention, from which the direct effect -- as measured in (2.12) -- could be subtracted to yield an estimate of the indirect effect. See, for example, Bowman (1978).

**The measurement of exogenous variables is either fixed by data collection measurement techniques (e.g., high school diploma, race, etc.) or is constrained by the grouping of the endogenous variable (e.g., unique cells of observations grouped by rating and YOS for the endogenous retention variable may dictate the range of AFQT scores on the mental ability variable)

form, parameter estimates from individual observation points can be derived with a maximum likelihood estimation (MLE) program. Alternatively, a less costly procedure for generating parameter estimates is to group the observations by cells -- as identified by the set of exogenous/pre-determined variables and the discrete values the observations can take within each cell -- and run an OLS routine on the grouped data.

Thus if the sample size is very large relative to the number of explanatory variables, one may choose to estimate the model with grouped data.* This procedure characterizes much of the recent CNA modeling, as well as other current retention models using large samples. This aggregation procedure has been justified on the grounds that the predictive power and parameter estimates of models using grouped data are highly similar to that using individual observations, as reported by Warner in his 1978 study on attrition behavior.

In addition, data constraints on key variables in the retention model, most notably expected civilian opportunity wages, may only be available in aggregate cohort form. To the extent this is true, one may be forced to use grouped data for the endogenous retention variable that is consistent with the groups defined for the relevant exogenous/pre-determined factors. A primary example of such constrained aggregation appear in early retention studies that used average civilian earnings for race, age, and education cohorts as reported in the Census Bureau's Current Population Survey (CPS).**

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*If a retention model has three "classifiers" (e.g., race, education, pay grade) and each is divided into 2, 3, and 6 groups respectively -- one has 2x3x6, or 36 cells with which to use as (grouped) observation points for the regression.

**See the studies referenced in the Gates Commission Report (1970).

This data constraint has become less binding in recent retention models that generate expected wages from extract files form the Social Security Administrations' Continuous Worker History Sample (CWHS). Most notably, all current CNA models can specify estimated civilian wages based upon an earlier human capital model developed with CWHS data by O'Neill and Ross (1976). As indicated earlier, however, the large data samples being analyzed allow one to use grouped data without loss of efficiency in estimating parameters in retention models.

With respect to the choice between grouped vs. individual observations in the present study, one must recognize that our sample size is "large" in a statistical sense for hypothesis testing, but stratified sub-samples with a large number of explanatory variables often preclude the grouping of data. In addition, we have chosen to use individual specific observations, which allow us to capture variations within broadly defined cells and improve the consistency of parameter estimates.

Relative Pay. The second set of issues with respect to measurement of variables is concerned with appropriate form of the relative pay variable in the retention models. As stated earlier, current data on actual longitudinal military and civilian earnings are not readily available.

As for military pay, the Defense Manpower Data Center (DMDC) has collected branch-specific data which are fairly complete for measures such as Regular Military Compensation (RMC). Extended data on bonuses, imputed value of medical service, commissaries, etc. are generally not available,

however. In addition, expected military retirement pay has been measured more accurately by weighting the pay by the average probability of re-enlistment for selected pay grades and YOS.

The major source of measurement error, however, occurs in the expected civilian opportunity wages of veterans at all possible YOS. In essence, we know very little about the level and growth of earnings of veterans more than a year after separation or retirement. To date, Warner's simplistic human capital model of the level of earnings provides researchers with the best estimates of the expected civilian opportunity wages for selected pay grades and YOS. As indicated earlier, other models use median earnings of reported age-earnings profiles of civilian age cohorts from the Census Bureau's Current Population Survey.

Regardless of the data source used, little is known about the growth in civilian earnings over any extended period of time. This salient, but overlooked, factor is the key to projecting the future earnings stream of veterans. For veterans with expected post-service labor force participation of 15-40 years, earnings in the first post-service year are a very incomplete statement of civilian wages opportunities.

C. Summary

The current status of retention modeling is largely an outgrowth of the need of Congress to base re-enlistment programs on quantifiable estimates of labor supply responses in the AVF era. The models used today represent slight refinements over those specified originally for the Gates Commission. Improved measures of the relative pay variable of reenlistees have been developed, but many empirical and methodological problems remain.

In particular, the omission of large scale longitudinal data on actual civilian experiences of veterans across varying YOS categories is a major characteristic of retention research. Thus even with the improved methodology of utilizying MLE techniques in a logistic framework, parameter supply estimates may still be subject to large (and possibly biased) measurement errors. In addition, many non-pecuniary factors may be directly and/or indirectly omitted from econometric retention models, resulting in a retention policy that may be based upon biased and inconsistent parameter estimates.

The first phase of this project may largely be viewed as providing additional information on pre- and post-Navy civilian opportunity work experience that has not been available in other retention models. These factors are described in more detail below.

CHAPTER 3

BEHAVIORAL PATTERNS

Before testing economic hypotheses about re-enlistment behavior, it may prove helpful to describe first actual retention patterns. That is the purpose of this chapter. First, the sample used in the retention models is identified, next aggregate retention rates are described across various lengths of service. These retention rates are then related to demongraphic factors (Section C), pre-enlistment work experience (Section D), in-service variables (Section E), and post-service work experience (Section F). These patterns put perspective on both expected retention probabilities and the economic "pay-off" to Naval service varying durations.

A. The Sample

A total sample of 11,368 male enlisted Navy personnel was chosen for statistical analysis. These individuals are representative of 1.14 million men who entered the Navy between the 1959-67 calender years, which were identified from the 1957-71 Social Security LEED file.

The first entry year 1959 was chosen to allow a two-year, pre-entry observation period. This permits measurement of the entrants' prior civilian work experience. Similarly, the last entry year, 1967, was chosen to allow time for enlistees to stay in the Navy for at least four years, the median first enlistment period during the observed time period.

The entry period is identified as the first quarter an individual is shown to be employed in the Navy. All records that showed more than

three quarters of non-employment (i.e. zero earnings) before the exit quarter from the Navy were eliminated. This was done because we did not have data on the actual entry date, and most individuals with more than three quarters of non-employment experienced them in the initial phase of their Navy careers. The uncertainty as to the cause of non-service in the early phase of one's enlistment period was reason to eliminate these observations.

A final restriction imposed upon the sample was that an initial rank had been observed. This condition was necessary because enlisted personnel were identified according to the quarterly base pay, which is the only component of military compensation subject to federal income tax, and thus observable on the LEED records. These quarterly base pay figures were assigned to the relevant pay grade cells for each calendar quarter and only those observations whose first rank (i.e. relevant quarterly earnings) could be identified as E-1 through E-7 were selected.

B. Retention Rates

1. Years of Service Distribution. The stay/leave decision characteristic of individual retention behavior is best modeled as a function of accumulated service and the time remaining in the current enlistment period. Accordingly, it is useful to describe first the actual service experience of the observation sample.

The distributions of length of service for Navy personnel who enlisted between 1959 and 1969 are indicated in Table 3.1. For the first seven entry years (1959-1965) the distribution patterns are very consistent. Nearly 20 percent complete less than three years of their initial obligation, while 30 percent complete a full four year initial enlistment period, and almost 40 percent enlisted for five or more years (most of which represent first term re-enlistees).

Table 3.1

Length of Navy Service by Entry Year
(percent distribution)

Entry Year	Length of Service				Entry Year Frequency Distribution
	1-2 Years	3 Years	4 Years	5+ Years	
1959	23.3	11.9	27.7	37.1	(9.0)
1960	16.9	10.6	33.1	39.4	(8.4)
1961	19.2	14.3	25.6	40.8	(9.8)
1962	18.9	13.7	25.2	42.1	(8.5)
1963	19.3	10.3	31.8	38.7	(7.9)
1964	19.8	12.2	37.7	30.4	(8.7)
1965	17.4	14.7	29.7	38.2	(9.6)
1966	16.0	20.1	53.9	10.1	(10.0)
1967	34.4	30.3	24.9	10.5	(8.2)
1968	57.0	6.8	36.3	0.0	(10.6)
1969	61.5	38.5	0.0	0.0	(9.2)
[Number]	[3,192]	[1,886]	[3,395]	[2,895]	[11,368]

Beyond 1965, the distribution pattern changes radically, and no one can be observed with five or more years of service by 1968. This truncation occurs because the data file only covers the period through 1971. As such, a severe truncation bias may exist for models using this data base for long enlistment periods, say those having ten or more years of service. It is for this reason that the models developed below focus roughly upon first term retention behavior (occurring during the third and fourth year of service for the 1959-1968 entrant enlistees file).

2. YOS Groups and Retention Modeling. As indicated in Table 3.1, three career junctures are identified, the first two occurring within a three year period from entry and the last after four years of service. In essence, the first two junctures are characteristic of first term completion decisions while the last is characteristic of the first re-enlistment juncture, i.e., the probability of completing five or more years conditional upon completing three years of Navy service.

The methodology of specifying varying career junctures in retention models assumes that factors which influence initial completion may not effect, or may be expected to have a significantly different effect on, the decision to re-enlist. In either case, the correct sub-sample used in retention models should consist of individuals who have completed a given length of service prior to the point in time that the re-enlistment decision is modeled. It is for this reason that the measure of retention used in the models below is the (conditional) probability of continuation.

C. Demographic Correlates of Retention

As is evident from Table 3.1, there is great variation in individual retention profiles. Some of this variation is associated with demographic characteristics, as is documented in the following paragraphs.

1. Entry Age. While most enlistees entered the Navy during the observed period at the age of 18, there is a significant variation of entry age. As seen in Table 3.2, nearly half of the enlistees were 18 years old or younger at entry, while nearly 30% were twenty or older. These older entrants may be expected to exhibit different retention behavior because of differing opportunity wages they command, itself determined by acquired work experience, skills, and education. In addition, differing "taste" for the military and marital status may be related to age, wich should be recognized when developing a model of retention behavior.

TABLE 3.2

Entry Age and YOS Distribution
(percentages)

Entry Age	(Frequency Distribution)	Years of Service 1-2	3-4	5+	Total
17	(18.5)	8.6	78.1	13.2	100.0
18	(29.9)	7.9	82.6	9.5	100.0
19	(23.3)	12.1	79.4	8.6	100.0
20	(13.5)	14.3	78.5	7.2	100.0
21+	(14.8)	16.1	73.8	10.2	100.0
TOTAL	(100.0)	11.1	79.1	9.8	100.0

As seen in Table 3.2, the probability of completing less than three years of Navy service increases substantially for older entrants. Very little variation occurs across age for those completing initial enlistment (3-4 years), however, once one completes initial enlistment, very young (less than 18) and relatively older entrants (21 plus) are significantly more likely to remain for five or more years.

2. Race. With whites composing roughly 89 % of the general population, it can be seen in Table 3.3 that they are over-represented in the Navy during this entrant period (1959-1968). In addition, the difference in race appears to have a significant effect on the probability of completing longer terms of service. While non-whites are slightly more likely to drop out before three years of service (13.4% vs. 10.9%), they are nearly twice as likely to re-enlist beyond four years of service (16% vs. 9.2%). This apparent race effect may be explained by the fact that non-whites confront lower civilian (opportunity) wages.

TABLE 3.3

Race and Navy Service
(percent distribution)

Race	(Frequency Distribution)	Years of Service 1-2	3-4	5+	Total
White	(91.5)	10.9	79.9	9.2	100.0
Non-White	(8.5)	13.4	70.6	10.0	100.0

3. Region. The composition of Navy enlistees by region is fairly evenly distributed, with the highest percentage from the North-Central states (29.9%) and the lowest from the Western states (19.3%). Furthermore, there appears to be little differences in completion rates during the first term enlistment period, although significant differences become noticeable for the re-enlistment juncture. As seen in Table 3.4, individuals living in the North Central and North East regions are slightly less likely to re-enlist as compared with the South and West; those from the West have the highest re-enlistment probabilities (8.5%) of all regions. These observed regional differences may underscore the potential usefulness of specifying recruiting districts in retention models.

TABLE 3.4

Region and Navy Service
(percentages)

Region	Frequency Distribution	YOS Distribution 1-2	3.4	5+	Total
North-East	25.8	42.8	51.2	6.0	100.0
North-Central	29.9	39.3	54.9	5.8	100.0
South	25.0	44.1	48.7	7.2	100.0
West	19.3	42.0	49.5	8.5	100.0

D. Pre-Enlistment Work Experience

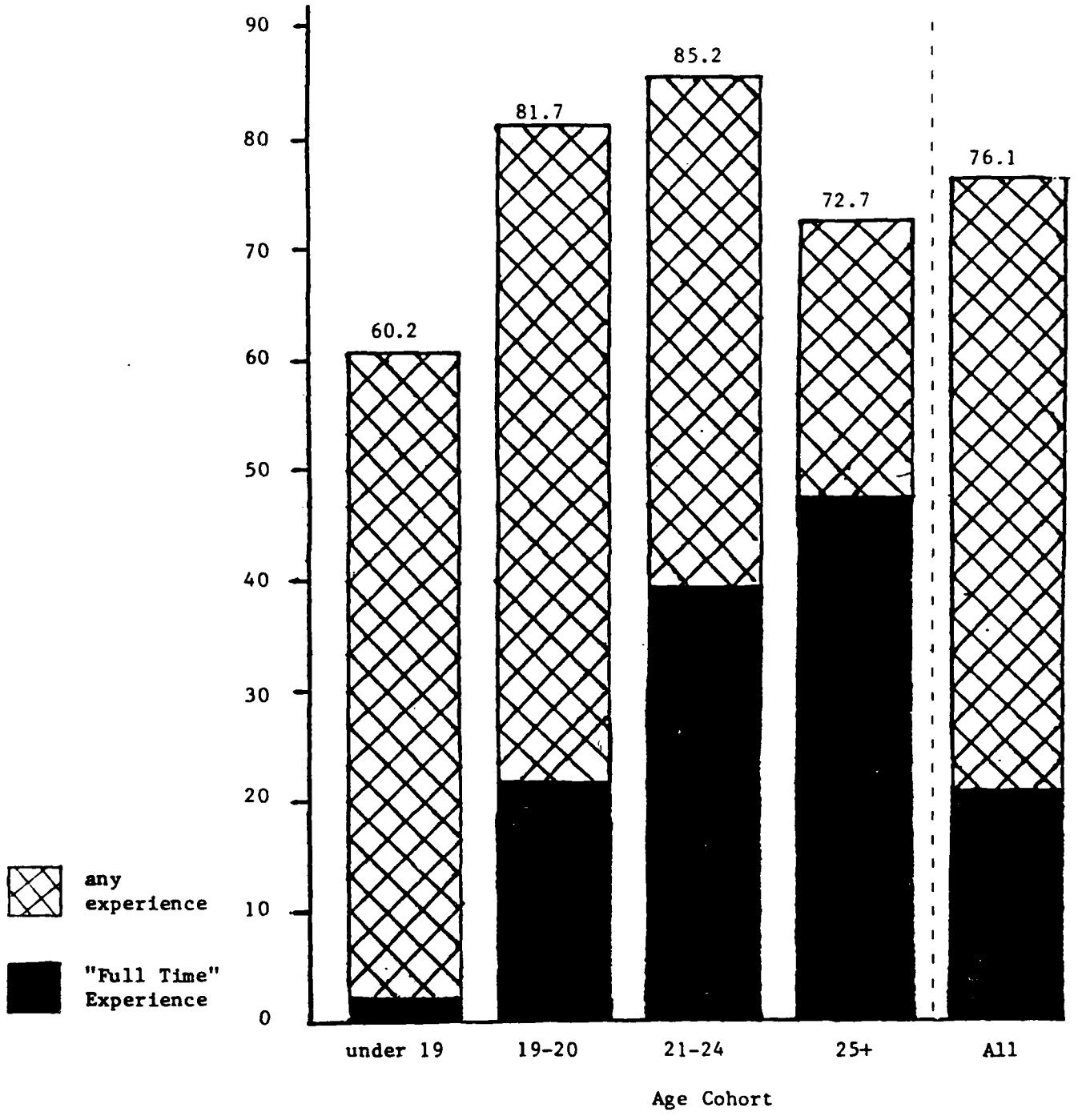
1. Prior Civilian Employment. One of the least understood characteristics about Navy enlistees during the period of observation involves the extent of prior experience. It is generally assumed that "raw" recruits have no work experience, having enlisted right after leaving school. Figure 3.1 below, however, indicates that a majority of enlistees had some prior experience and older enlistees had acquired substantial work experience in the calendar year prior to enlistment.

Over three-fourths of all enlistees had worked and earned positive wages in the year prior to entry. Furthermore, over 20 percent had worked "full-time" -- defined as earning at least as much a a year-round job at the minimum wage (roughly $2,000 per year).* In addition, it is also important to note that while the bulk of Navy enlistees are under 19 at entry, older enlistees

*While $2,000 seems artificially low for full-time employment, one must recognize that when stated in 1982 dollars this figure translates into $6,732 and $5,830 for those entering in 1959 and 1968 respectively. In today's terms, full-time employment at the minimum wage ($3.35/hr.) would equal $6,300 which is roughly equal to the average ($6,281) of the imputed full-time earnings of the two selected periods above.

Figure 3.1

Civilian Work Experience of Enlistees, by Age



Note: Experience in year prior to enlistment.

TABLE 3.5

Pre-Enlistment Work Experience and Navy Service
(percent distribution)

	Years of Service			
	1-2	3-4	5+	Total
None	9.1	77.3	13.7	100.0
Part-time	11.3	79.7	9.0	100.0
Full-time	14.0	80.3	5.8	100.0

especially have substantial full-time employment. From 40 to 50 percent of enlistees aged 21 and over had acquired substantial experience prior to entry.

As shown below in Table 3.5, experience appears to be negatively correlated with length of service. Prior work experience increases significantly the probability of dropping out before completing the first enlistment period (14.0% vs. 9.1%) and decrease the probability of remaining five or more years. Only 5.8% of those having full-time prior experience re-enlist, as compared with 9% who worked part-time and 13.7% without any prior experience.

These figures suggest that prior work experience adds to one's stock of human capital and thereby improves civilian sector opportunities following initial enlistment. Work experience may also enhance one's ability to acquire skills in the Navy.* Finally, civilian work experience may diminish one's relative taste for military work.

While one cannot identify the skill level or occupation of pre-Navy employment with the LEED data file, industry affiliation is known down to the four-digit SIC level. For the sake of exposition, Table 3.6 ranks the top 15 two digit SIC industries, as defined by the proportion of veterans with pre-Navy work experience in an industry who completed five or more years of Navy service, i.e. the "longer-term" enlistees.

The list of industries in Table 3.6 is suggestive that the skill content of full-time work experience may be expected to vary substantially over pre-Navy civilian employers. Low skilled sectors such as motion pictures, health services, and amusement and recreation stores all have a high proportion of longer-term enlistees. One would not expect the skill content in these sectors to be high nor the transferability of acquired skills to be made directly

*It may be noted that "human capital" as used here includes the development of worker traits such as work responsibility, punctuality, ability to work with others, etc. as well as the more common measure of on-the-job training.

into specific Navy ratings. Other industries, however, may provide a relatively high level of early job skills which may be directly transferable to Navy service, such as ordinance and accessories, communication, and auto repair services.

High skilled prior civilian sector employment may not, however, be reflective of a strong retention program for the Navy. That is, if recruitment or training effort were to be focused upon those with higher-skilled prior work experience, one may run the risk of improving the attractiveness of these individuals to private sector employers, especially after enhanced training acquired in the Navy. As a result, recruiting efforts targeted to these sectors may worsen, not improve, retention rates. As an example, as seen in Table 3.7, selected industries such as transportation equipment (including shipbuilding), electrical machinery, and water transportation -- all industries which seem to have a high degree of skill transferability to the Navy -- are characterized by relatively low proportions of longer-term enlistees.

Whereas the previous tables have indicated the distribution of longer-term enlistees across various industries, Table 3.8 indicates the major source of longer-term veterans having prior work experience. Fifteen two-digit industries (out of a total of seventy-three) account for nearly two-thirds of all previous work experience of Navy enlisted personnel; ten account for roughly half of all experienced personnel.

In summary, many Navy enlisted personnel of this time period had some work experience prior to entry -- and much of it was concentrated in a few selected industries. While two-thirds of enlistees with prior work experience came from 15 industries, only five of these had above average proportion of longer-term enlistees. These preliminary figures are indicative of the highly variable nature of prior work experience and of the varied correlation prior experience may have with length of Navy service.

Table 3.6

Major Pre-Navy Industry Affiliation of Longer Term Enlistees [a/]

Pre-Enlistment Industry Affiliation	Percentage of Longer-Term Enlistees in Industry
Motion Pictures	17.3
Health Services	15.5
Amusement and Recreation Services	14.9
Apparel and Accessory Stores*	14.5
Government*	13.6
Lumber and Wood Products	13.3
Hotels and Other Lodging Places*	13.2
General Merchandise Stores*	13.2
Ordnance and Accessories	13.0
Communication	12.9
Agricultural Production*	12.5
Non-Building Construction*	12.5
Food Stores*	12.2
Automotive Repair Services	11.6
Furniture and Equipment Stores	11.3
Average of Covered Enlistee	10.7

[a/] Includes only those industries having over 1,000 observations from 1960-68.

*Major Pre-Navy Industry of all enlistees, regardless of length of service.

Table 3.7

Selected Industry Affiliation of Longer-Term Enlistees

Industry in Year Prior	Percentage of Longer-Term Enlistees in Industry
Top Five	
Motion Pictures	17.3
Health Services	15.5
Amusement and Recreation Services	14.9
Apparel and Accessory Stores	14.5
Government	13.6
Bottom Five	
Transportation Equipment (including Shipbuilding)	3.7
Electrical and Electronic Machinery	3.6
Furniture and Fixtures	3.6
Concrete Products	3.1
Textile Mill Products	1.6
Miscellaneous	
Water Transportation	4.0
Reserves	0.0
Average	10.7

2. Pre-Entry Wages. A second dimension of pre-enlistment work experience is the level of wages in the year prior to entry. For the 76.1% of enlistees who had prior work experience, the distribution of wages (in 1982 dollars) is given in Table 3.9.

As clearly seen, the variation in the level of prior wages is large. Nearly one-fourth (24.3%) of enlistees who worked earned less than $1,000 (1982 prices) while over ten percent (10.6%) realized in excess of $10,000. While mean wages were $4,105, a large variation about the mean ($4,203 standard deviation) results in a coefficient of variation in excess of one (1.024).

As seen in Table 3.10, the correlation of prior wages of those earning less than $10,000 (90% of covered workers) with completion of first term enlistment is slight. Completion probabilities vary by 2.2% and 3.4% across the earnings brackets for those completing 1-2 and 3-4 years respectively.

Completion rates do vary significantly across earnings brackets for longer term enlistees, however. Whereas 11.9% of those with earnings less than $1,000 completed five or more years of service, as compared with only 6.4% of those with earnings between $4,000 to $10,000. The universe relation between prior earnings and re-enlistment probabilities is supported further by noting that only 5.6% of those who realized over $10,000 prior to entry remained in the Navy five or more years.

In summary, both pre-entry employment and wage histories suggest that individuals with a greater accumulation of work related human capital are less likely to remain for longer years of Navy service.

Table 3.8

Major Source of Enlistees
By Pre-Navy Industry Affiliation

Major Industry Affiliation	Percent of Covered Enlistees: One Year Prior to Entry
Food Stores*	13.6
Eating Places	6.5
Automotive Service Stations*	6.0
General Merchandise Stores	4.5
Wholesale Trade	4.4
Construction -- Special Trade	3.8
Agricultural Projects -- Crops	3.7
Food	3.8
Miscellaneous Retail	3.5
Government*	2.7
Recreation Services*	2.5
Machinery	2.2
Building Construction	2.3
Printing and Publishing	2.0
Non-Building Construction*	1.8
Sub-Total	62.5

*Major employer of longer-term enlistees.

TABLE 3.9

Pre-Entry Annual Wage Distribution

Wage (1982 dollars)[a]	Percent
1 - 999	24.3
1,000 - 1,999	17.0
2,000 - 3,999	22.1
4,000 - 5,999	26.0
6,000+	10.6

Mean:	$4,105.
Standard Deviation:	$4,203.
Coefficient of Variation:	1.024

[a]Wage figures derived by multiplying the level of annual wages in the calendar year prior to entry by a relative price index. This index is a ratio of the total Consumer Price Index (CPI) for 1982 (291.5) to the CPI for the particular calendar year (1958-68).

TABLE 3.10

Pre-Entry Wages and Navy Service

(percent distribution)

Wages (1982 dollars)	Years of Service (YOS) 1-2	3-4	5+	Total
1 - 999	27.6	60.4	11.9	100.0
1,000 - 1,999	25.3	63.2	11.5	100.0
2,000 - 3,999	27.1	64.2	8.6	100.0
4,000 - 9,999	29.8	63.8	6.4	100.0
10,000+	45.0	49.4	5.6	100.0

As seen in Table 3.10 higher prior wages appear to have a positive.

E. In-Service Correlates of Retention

A third set of factors related to the probability of completing additional years of Navy service is related directly to one's experience in the military. As noted earlier, very little information is known at this time about the military experiences of our sample. The only observable variables are prior reserve duty, first rank and rate of promotion.

1. Prior Reserve Duty

Less than ten percent (9.4%) of enlistees were ir the Naval Reserve prior to active duty. In addition, prior Naval reserve duty appears to be highly correlated with completing relatively short periods of active duty. Nearly one-fourth of former reservists (22.2%) complete less than three years of active duty as compared to one-tenth (9.9%) of non reservists. However, prior reserve status does not appear to be related to re-enlistment. Of those with prior

reserve duty 9.4% remain for more than four years on active duty as compared with 9.8% of the non-reservists.

TABLE 3.11

Prior Naval Reserve and Years of Service

Prior Naval Reserve Status	(Frequency Distribution)	Years of Service 1-2	3-4	5+	Total
Yes	(9.4)	22.2	68.5	9.4	100.0
No	(90.6)	9.9	80.2	9.8	100.0

2. Entry Rank.

Based upon the monthly base pay, one may approximate the entry rank of enlistees with the LEED file. This identification process is not exact since quarterly wage figures are observed and individuals enlist at varying periods during a quarter. In addition, early promotions are common and the quarterly figures may reflect a combination of two ranks.

In light of these difficulties, one may identify the first rank, which is most likely the entry or next higher rank. In either case, as indicated in Table 3.12, less than twenty percent (17.2%) realized a rank greater than E-2 (Seaman Apprentice) in their first year of Navy service. In reality most of these with the first rank of E-3 or higher had an entry rank one rank less. As such, those who entered at grades E-3 or higher (i.e., "lateral entrants") composed 3% of all entrants, and many of these no doubt were prior service enlistees. (During this period very few non-prior service enlistees were processed through the official Navy lateral entry program.)

TABLE 3.12

First Rank and Navy Service
(percentages)

First Rank[a]	(Frequency Distribution)	Years of Service 1-2	3-4	5+	Total
E-1/E-2	(82.8)	9.4	80.3	10.3	100.0
E-3	(18.4)	17.9	75.4	6.6	100.0
E-4 or higher	(3.0)	24.9	65.8	9.3	100.0

While higher first rank appears to increase the probability of relatively short periods of Navy service (i.e., 24.9% of those with a first rank of E-4 or higher completed less than three years of service as compared with only 9.4% of those with a first rank of E-1/E-2), smaller differences appear for longer YOS categories. Of those with a first rank of E-1/E-2, 10.3% remain for more than four years as compared with 9.3% of those with a first rank of E-4 or higher. However, it may be noted that of the 14.2% of enlistees whose first rank was E-3, only 6.6% of them remained for more than four years -- substantially less than the E-1/E-2 group of enlistees.

3. Rate of Promotion

The last in-service factor known at this phase of the project is the rate of promotion, as calculated as the difference between the rank identified in the third YOS and the first YOS. As shown in Table 3.13, there is a large variation in the measured promotion rate; over one fourth experienced relatively low rates of promotion (0-1 ranks) and another fourth relatively high rates of promotion (3 or more ranks), with 41.8% experiencing a 2 rank promotion rate prior to the fourth year of service.

Furthermore, promotion in this early period of Navy service appears to be positively correlated with the length of service. The probability of re-enlistment roughly doubles for those with relatively high early promotion rates as compared with those realizing low rates of promotion (24.1% vs. 12.4%). This pattern may indicate that those who are rewarded more highly for their early efforts in their Naval career are more likely to remain beyond their initial enlistment period.

F. Post Navy Work Experience of Veterans

A major explanatory variable in econometric modeling of re-enlistment behavior is post-service work experience. While the theory of opportunity wage streams (based upon expected employment patterns and wage measures) is the cornerstone of such models, little is known about perceived work opportunities, let alone the actual experiences of enlistees. The LEED file is especially attractive for deriving estimates of these civilian labor market experiences, as measured by the longitudinal pattern of employment and earnings of those who chose to leave the Navy.*

The discussion of veteran work experience may be divided into their wage and employment histories. Four salient observations of veteran wage histories are:

(1) average veteran wages are competitive with similar aged males from the total civilian population;

(2) variation in veteran wages is extensive across industry affiliation;

(3) impressive veteran wage growth patterns differ widely by industry affiliation;

(4) veteran earnings vary simultaneously with both prior- and in-service work experience.

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*As explained in detail below, these estimates of opportunity wages are biased upwards if those who leave have higher opportunity wages than those who re-enlist.

TABLE 3.13

Rate of Promotion and Navy Service
(percentages)

Rate of Promotion[a]	(Frequency Distribution)	Years of Service 3-4	5+	Total
0 ranks	(3.7%)	87.6	12.4	100.0
1 ranks	(23.8%)	86.5	13.5	100.0
2 ranks	(41.8%)	85.3	14.7	100.0
3+ ranks	(23.8%)	84.0	16.0	100.0
4+ ranks	(6.8%)	75.9	24.1	100.0

[a]Measured as the difference between rank in the third YOS from the first YOS.

In addition, veteran employment histories are also characterized by the extensive variation in the degree of labor force attachment in industry affiliation, and in job mobility across industries following Navy service.

1. Veteran Wage Histories

As seen in Table 3.14, mean wages of the veteran sample (in 1982 dollars) in the year following exit were $12,669. The variation is extensive, however, as over one-third made less than $10,000 and another third earned in excess of $15,000. It may also be noted that the average veteran earnings compares favorably with that of the average year-round, male-worker aged 20-24 ($13,500). It must be recognized that the average age of the veteran sample in the first year following exit is approximately 21 years of age, whereas the U.S. average combines earnings of men aged 20 to 25. It appears that employed veterans of this era did not suffer significantly as compared with year-round workers, most of which did not have their work history interrupted by military service.

A second, and even more impressive, feature of veteran's wage history is that the variation about the mean level of wages is pervasive as seen across industry affiliation. Average wages vary from a low of under $10,000 in automotive services to a high of nearly $17,000 in air transportation - as seen in Table 3.15 and in Figure 3.2.

Of even greater significance is the extent of wage growth in the three years following Navy service. Whereas (state and local) government employed veterans experienced only a 6.5% real annual growth rate, those employed in automotive services, air transportation, and communications realized from 18% to 20% real growth rates. All veterans in covered sectors realized a

TABLE 3.14

Wage Distribution of Covered Veterans in Year Following Exit (1982 dollars)

Wages in Year Following Exit	Percent Distribution
1 - 999	3.4
1,000 - 4,999	12.2
5,000 - 9,999	19.6
10,000 - 11,999	9.9
12,000 - 14,999	17.3
15,000 - 17,999	16.1
18,000 - 19,999	8.9
20,000+	12.8
Mean	$12,669.
U.S. Average, 4 qr. workers (males aged 20-24)	$13,500

Table 3.15

Post-Navy Earnings of Longer-Term Enlisted Veterans,
By Selected Industries*

Major Industry Affiliation	Mean Earnings in Year Following Exit		Percentage Annual Earnings Growth
	First	Third	
Machinery	15,100	18,000	9.5%
Transportation Equipment	15,400	17,300	6.0
Wholesale Trade**	12,300	16,200	16.0
Electronic Machinery	14,600	18,300	12.5
Government (State & Local)	11,600	13,100	6.5
Primary Metals**	13,600	17,200	13.0
Special Trade Construction**	13,100	17,400	16.5
Communication**	13,900	18,900	18.0
Automotive Services**	9,900	13,900	20.0
Food	11,600	14,500	12.5
Fabricated Metals Products**	13,000	15,600	10.0
Air Transportation**	16,600	23,100	19.5
Covered Workers	12,600	15,800	12.5
U.S. Average, 4 quarter workers, (males aged 20-24)***	13,500	13,800	2.0

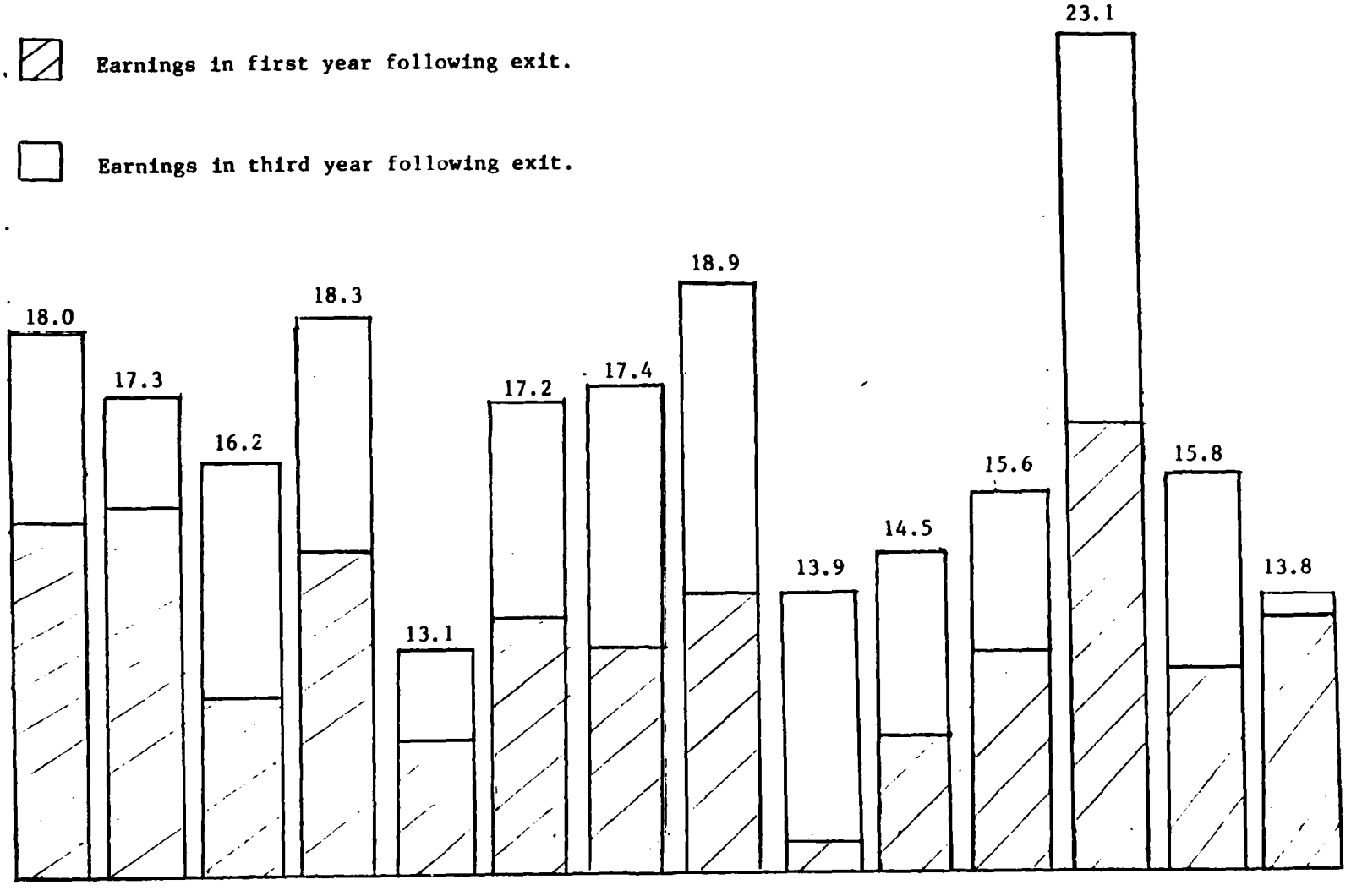
*Earnings stated in 1982 dollars.

**Major industries realizing a significant increase in proportion of covered workers.

***Calculated for 1966 and 1968, the mean post-navy years of the veteran sample.

FIGURE 3.2

Chart of Longer-Term Enlisted Veteran Earnings of First to Third Year Following Exit: (1982 dollars)



12.5% annual increase, which was impressive even for the fast growth period in the late 1960's.* These figures suggest that civilian opportunities in the year following exit are only one influence on the re-enlistment decision. Perhaps of even greater importance is the perceived wage growth, whose actual pattern varies widely across industry attachment of veterans.

A final dimension of the pattern of veteran wages is their apparent relation with prior-service and in-service factors. In Figure 3.3, it can be clearly seen that pre-service employment is significantly related to post-service wage levels. Those who worked full-time prior to entry earned $16,000 in the first year as a veteran, as compared with only $12,500 for those who acquired part-time experience and $11,500 for those without any pre-enlistment job experience.

In addition, those with longer service appear to be underrepresented in the low wage post-Navy wage ranks and overrepresented in the high wage ranks. As can be seen in Table 3.16, less than 4% of those earning less than $5,000 had acquired five or more years of service; likewise over 10% of those earning in excess of $20,000 had acquired five or more years of service. These last figures are suggestive of the human capital explanation of individual earnings.

2. Veteran Employment Histories

A second dimension of Post-Navy work experience is the length of employment in total and by industry affiliation. As noted earlier, little is known with respect to the longitudinal employment history of veterans. Table 3.17

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*It may be noted that the 2% annual increase in average earnings for the total civilian population cannot be readily compared to the 12.5% increase of veterans. In the latter, the same individuals are included in the 12.5% figure, much of which reflects the increased work experience acquired - in addition to the maturation effect - of the veteran cohort that is three years older. In contrast the U.S. average figure reflects average wages for different individuals of two similarly aged cohorts whose earnings are measured at two distinct points in time (1966 and1968). Thus much of the increased work experience plus the maturation effect is not captured in the U.S. figures.

Figure 3.3

Post-Navy Civilian Earnings of
Longer Term Enlisted Veterans By Pre-Navy Experience

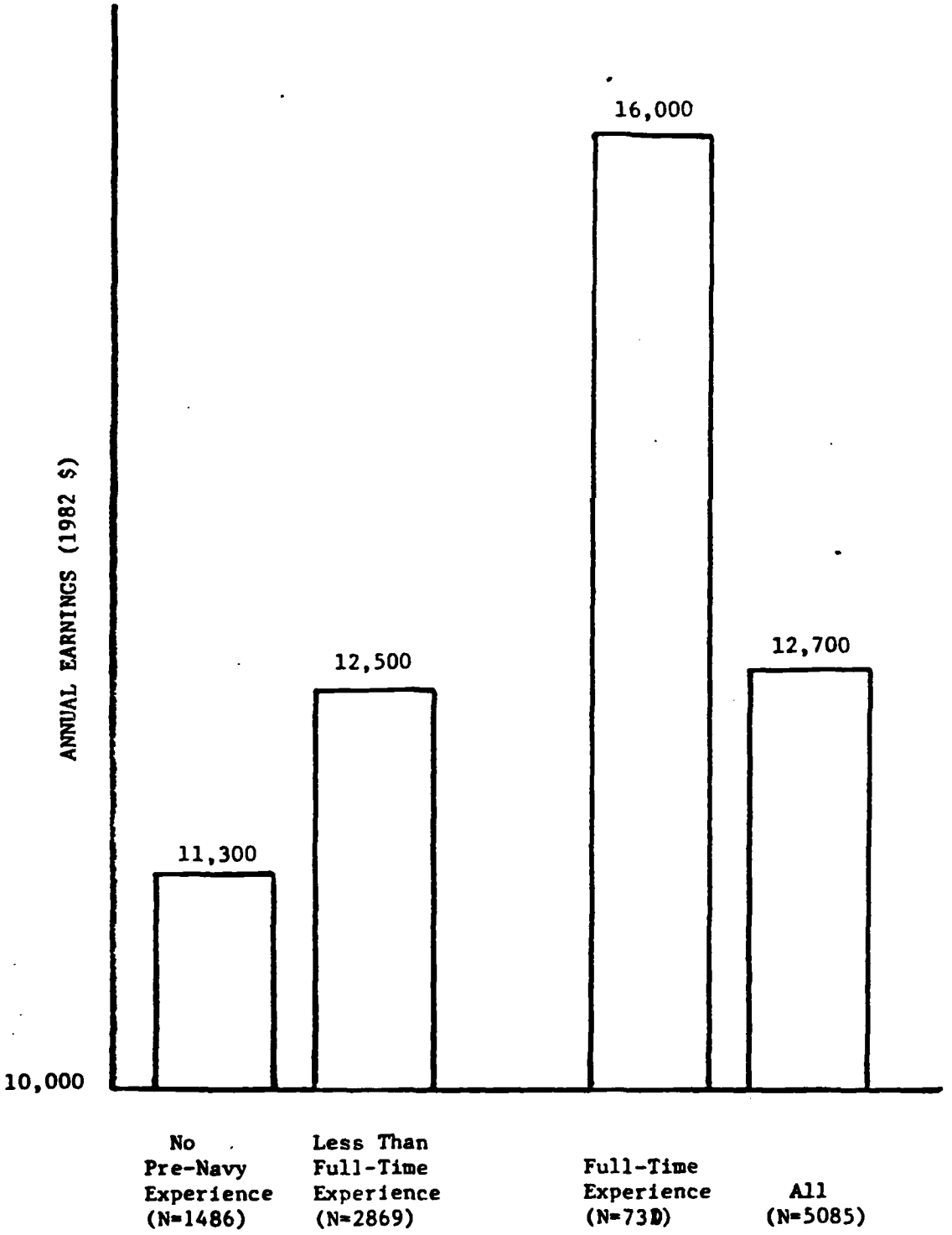

TABLE 3.16

Post-Navy Annual Wage and Years of Service
(percent distribution)

Wage in Year Following Exit	Years of Service 1-2	3-4	5+	total
1 - 999	47.6	48.6	3.8	100.0
1,000 - 4,999	39.5	57.5	2.4	100.0
5,000 - 9,999	36.2	59.4	4.4	100.0
10,000 - 11,999	33.8	61.8	4.5	100.0
12,000 - 14,999	29.9	67.3	2.8	100.0
15,000 - 17,999	27.2	69.0	3.8	100.0
18,000 - 19,999	26.5	68.3	5.2	100.0
20,000+	24.8	64.0	11.2	100.0

summarizes the degree of labor force attachment over the first three years following exit from the Navy. As indicated, covered employment decreases from 93.0% to 80.3% over the three year period. This may reflect a growing percentage of veterans being employed in the non-covered, especially federal government, sector or being a full-time student or actually employed. One may also note that of those employed, a growing proportion become employed full-time over the post-Navy period -- from 76.9% to 83.1%. As such, these figures suggest that the increase in "non-employment" may in fact be due to a growing percentage of veterans becoming employed in the non-covered federal government sector. This interpretation of the findings would be consistent with the fact that more veterans work more and earn higher salaries as indicated by the 6.2% point increase in the number of full-time covered veterans.

TABLE 3.17

Post-Navy Employment History
of Veterans in Covered Sector

Covered Employment[a]	Years Following Exit 1	2	3
Non-Employment	7.0	15.6	19.7
Employment	93.0	84.4	80.3
Part-time (% of Employed)	(23.1)	(18.5)	(16.9)
Full-time (% of Employed)	(76.9)	(81.5)	(83.1)

[a]Employment classified as part-time is measured by annual earnings (1982 dollars) less than $6,000; full-time employment is measured by annual earnings in excess of $6,000.

While Table 3.17 is instructive in giving one a sense of workforce attachment, of greater interest to the Navy is the pattern of employment by industry affiliation and YOS categories. The first relation between length of service and post-Navy industry affiliation of veterans is shown in Table 3.18. From 50% to 60% of the covered sector veterans are found to be employed in twelve major 2-digit SIC industries.* Just over half of covered sector short-term enlistees (e.g., those with three or less years of service) are employed in these major industries with half of these concentrated in machinery, transportation equipment, wholesale trade, and automotive services.

Longer-term enlistee industry affiliation upon exit differs from short-term affiliation in two ways. First, 14% more veterans are concentrated in these twelve industries (e.g., 59.1% as compared with 51.8%), and the composition across selected industries differs. Longer-term enlistees are much more likely to be employed in electronic machinery (+2.9% points), machinery (+2.3% points), and air transportation (+1.5% points). Likewise they are less likely to be employed in automotive services (-1.6% points), fabricated metal products (-1.2% points), and special trade construction (-0.6% points).

These varying industry affiliations suggest that varying wage opportunities may be related to length of service if wages differ across industries significantly.

Table 3.19 extends the analysis of industry affiliation of longer term enlistees to capture dynamic changes in industry employment patterns over a three year post-Navy period.

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*The reader may recall that fifteen major industries accounted for roughly 41% of recruits, suggesting that the Navy may be an important source of specific experience that is related to a relatively narrow range of industries.

Table 3.18

Major Industry Affiliation in Year Following Navy Service
By Length of Enlistment: (percent distribution)

Major Industry Affiliation	Proportion of Covered Enlistees: One Year After Service		
	Short-Term[a]	Longer-Term[b]	Longer-Term Less Short-Term
Machinery	6.7%	9.0%	+2.3%
Transportation Equipment	6.4	7.8	+1.4
Wholesale Trade	7.8	7.4	-0.4
Electronic Machinery	4.0	6.9	+2.9
Government (State & Local)	3.4	4.7	+1.3
Primary Metals	3.8	4.4	+0.6
Special Trade Construction	4.4	3.8	-0.6
Communication	2.6	3.6	+1.0
Automative Services	5.1	3.5	-1.6
Food	2.8	2.9	+0.1
Fabricated Metals Products	3.7	2.5	-1.2
Air Transportation	1.1	2.6	+1.5
Sub-Sample of Covered Workers	51.8%	59.1%	+7.3%
Number of Covered Workers	[14,970]	[908]	

[a]Completed three or less years of service.

[b]Completed five or more years of service.

Of the three industries which attracted a significantly greater proportion of longer term enlistees in the year following exit, only air transportation showed a positive (or non-negative) change in industry affiliation two years later. Further evidence of industry mobility is shown in the table whereby all of the three industries which attracted a significantly smaller proportion of longer-term enlistees in the year after exit, showed gains in employment concentration by the third year following exit.

Finally, Table 3.20 shows the mobility of individual longer-term enlistees across the covered sector employers. Sixty percent of those initially employed in one of the major industries identified above changed industry affiliation two years later and nearly two-thirds of them (39% of 60%) were employed outside of the major group of twelve industries.

Part of the explanation in the industrial mobility patterns of individuals may be found in the variability of the wage growth patterns by industries, as indicated earlier (Table 3.15).

G. Summary

The average length of Navy service for the 1957-67 entrants was 3.5 years, however there is a large variance in the duration of service as some individuals failed to complete their first enlistment tour and others chose to make the Navy their long-term career. The purpose of this chapter has been to identify potential demographic and economic correlates with such retention behavior which may then be included in the models developed below.

As expected, age, race, and region appear to vary systematically with retention behavior. More significant outcomes were found, however, with both pre- and post-Navy work experience correlates with retention behavior.

Table 3.19

Major Industry Affiliation of Longer Term Enlisteed Veterans Over Three Year Post-Navy Period: (percent distribution)

Major Industry Affiliation	Proportion of Longer-Term Covered Enlistees: One Year After Service	Three Years After Service	Change From One to Three Years
Machinery*	9.0%	5.6%	-3.4%
Transportation Equipment*	7.8	8.4	+0.6
Wholesale Trade	7.4	12.3	+4.9
Electronic Machinery*	6.9	6.4	-0.5
Government (State & Local)*	4.7	4.6	-0.1
Primary Metals	4.4	6.3	+1.9
Special Trade Construction	3.8	6.3	+2.5
Communication*	3.6	4.5	+0.9
Automotive Services	3.5	5.6	+2.1
Food	2.9	3.6	+0.7
Fabricated Metals Products	2.5	3.6	+1.1
Air Transportation*	2.6	3.7	+1.1
Sub-Sample of Covered Workers	59.1%	70.9%	+11.8

*Industries employing a significantly greater proportion of longer-term enlistees as compared with short-term enlistees in year following service.

Table 3.20

Industry Mobility of
Longer-Term Enlisted Veterans in
Selected Major Industries*
(percent distribution)

Industry Affiliation in Year After Exit	2-Digit SIC Industry Leavers	Major Industry Leavers[a]
Machinery	53	37
Transportation Equipment	59	51
Wholesale Trade	65	42
Electronic Machinery	62	38
Government (State & Local)	71	33
Primary Metals	64	41
Special Trade Construction	55	37
Communication	43	29
Automotive Services	67	30
Food	70	43
Fabricated Metals Products	64	16
Air Transportation	41	37
Sub-Total	60	39

*Mobility measured from first to third year following exit.

[a]Percentage of 2-digit SIC industry leavers who also become employed outside the major group of twelve industries.

It appears that much of the pre-service experience increases the stock of human capital, thereby raising enlistee's post-service civilian opportunity wages and lowering retention probabilities. This is particularly evident in manufacturing jobs, although much less so in the service sector. In addition, it may be noted that much of the pre-service experience is concentrated in a relatively few number of industry groups.

While this chapter has documented the extensive nature of pre-Navy civilian work experience of enlistees, of even greater significance is the description of actual post-Navy experience of veterans. While wage levels in the immediate post-Navy period are commensurate with average wages of the civilian population, wage growths over the three year period are more impressive - averaging in excess of 12% per year in real (1982) dollars.

The variation in post-Navy employment patterns documented above further stresses the importance of longitudinal work experience data. While the employment distribution of veterans across industries is even more narrowly focused than pre-Navy employment, both the actual wage growth and corresponding length of Navy service is significantly related to post-Navy industry affiliation. Certain industries were characterized by both high growth rates and an overrepresentation of longer term enlistees. These problems indicate that cost effective re-enlistment programs could develop improved measures of civilian opportunity wages according to the industry affiliation of veterans across various years-of-service categories.

It must be emphasized, however, that the dynamics of the industry affiliation are highly complex. While roughly 40% of veterans did not change their industry affiliation over the three year post-Navy period, 60% of those who did leave remained employed within twelve major industries.

This dynamic pattern of employment across industries displaying highly variable wage growth rates suggests that current estimates of civilian wage opportunities used in retention models may be subject to a far more serious type of measurement error as compared with the errors associated with selectivity bias of veteran versus active duty personnel wage opportunities. Any relative pay variable based upon the mean wage of an age-race-sex cohort in the year following exit certainly contains a large source of measurement error, especially when these measures are used as a basis for projecting life cycle earnings streams for up to forty or more years. Clearly more research must be directed to obtaining improved estimates of the actual longitudinal patterns of veterans earnings along with the work done to estimate the selectivity bias of (incorrectly measured) civilian earnings.

In the models derived in the following chapter, civilian wage opportunities are correlated with the demographic and in-service factors described above.

CHAPTER 4

OPPORTUNITY WAGES AND RE-ENLISTMENT

Both theory and experience suggest that job prospects in the civilian sector have a major influence on retention decisions. In particular, the civilian income alternatives available to Navy personnel may exert a significant influence on (re)enlistment decisions. Generally, these civilian opportunities are referred to as opportunity wages. Specifically, the opportunity wage refers to the best civilian job an enlistee could secure if he were not in the Navy.

An essential feature of the opportunity-wage concept is its individualized nature. In principle, each enlistee has a unique opportunity wage, conditioned on his abilities, experience, initiative, and other marketable characteristics.

Another feature of opportunity wages is that they are generally unobservable. Only the wages of a job held are observable. Yet, opportunity wages refer to the next-best alternative, i.e., to a job not held. Hence, any empirical discussion of the influence of opportunity wages on (re)enlistment decisions must be based on estimated opportunity wages. As we shall see, alternative estimation procedures can lead to very different estimates of opportunity wages.

It should also be emphasized that Navy personnel themselves must make decisions on the basis of unobserved opportunities. Relatively few enlisted personnel are likely to postpone their re-enlistment decision until a specific and known job alternative is presented. Generally, re-enlistment decisions must be made at specific time junctures, thus precluding continuous comparisons of

military and civilian opportunities. As a result, re-enlistment decisions are apt to be made on the basis of perceived opportunities. These perceptions are themselves likely to be influenced by observations of former mates, other veterans, friends, and self-assessments of market potential. In this sense, both the enlisted personnel making (re)enlistment decisions and the analysts who examine their decisions operate from similarly incomplete data bases.

In this chapter, alternative measures of opportunity wages are discussed first. Then our own technique for estimating opportunity wages is explained and implemented. Finally, the impact of estimated opportunity wages on individual re-enlistment decisions is assessed.

A. Alternative Measures of Opportunity Wages

There are a variety of observations that can be used as the basis for estimating opportunity wages. Two of these bases are of particular interest for this study, namely:

- o wages of comparable civilians
- o actual wages of veterans.

1. Civilian Wages

Wage profiles of the civilian labor force certainly provide a complete inventory of alternative wage opportunities. The problem, of course, is to identify that segment of the civilian-sector wage profile that best represents the opportunity wages of Naval personnel. In principle, this would be done by identifying civilians with identical income-earning characteristics, then using their labor-market experiences as a proxy for opportunity wages. In practice, such an identification process is impossible. We do not know all the determinants of wages, nor their relative significance, despite the hundreds of

wage studies that have been conducted. Moreover, even if we did have a fully developed explanation of wage differences, the data required to implement it are never completely available. As a consequence, relatively few characteristics are used to identify "comparable" civilians and their wage experiences. In fact, most empirical models of military retention use only age, sex, and race as a basis for comparability. Accordingly, the actual wages of civilians in a particular age-race-sex subgroup are used as a proxy for the opportunity wages of Navy personnel with those same demographic characteristics.* On occasion, educational attainment is used as a fourth dimension in identifying comparable civilians.** Occupational affiliation is also employed, but is of relatively little use for assessing the civilian potential of raw enlistees who have no occupational affiliation.

2. Veteran Wages

The second general source of information on opportunity wages is the actual labor-market experience of veterans. Veterans who re-enter the civilian labor force quickly learn what their true wage opportunities are. Hence, their experiences can provide "real world" insights into the opportunity wages of personnel still active in the Navy. Indeed, personnel still in active service are likely to base their perceptions of alternative job prospects on the observed experiences of recently separated veterans.

At first glance, the actual wages of veterans would seem to be a much better measure of opportunity wages than that provided by a cross-section of all civilians. The veterans are not only likely to share many common traits

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*See for example: Bryan and Singer (1965), Wilburn (1970), Gotz (1979), and Enns (1977) among others.

**See for example: Gotz (1980) and Enns (1982).

and experiences with still-active personnel, but are also burdened with comparable periods of nonparticipation in the civilian labor force. They also share any benefits or handicaps attached to veteran status per se.*

Veteran earnings are far from a perfect measure of opportunity wages, however. By definition, veterans have made a decision not to continue in active service. One of the factors that might have influenced that decision is opportunity wages. In particular, the opportunity wages of personnel who quit active service may be different from the opportunity wages of those who don't quit. Indeed, if opportunity wages are a significant influence on (re)enlistment decisions, this is almost certain to be the case. As a result, veteran earnings are likely to be an imperfect and potentially biased measure of opportunity wages.**

Although selection bias is a potentially serious problem, it is not unique to veteran earnings. Civilians who chose not to enlist in the military presumably also confronted opportunities that were different from those enlistees faced. Hence, civilian comparison groups are also subject to selection bias.

Even when selection bias is recognized, it need not lead to rejection of the veteran's data base. If the variability in veterans' earnings can be explained, it may be possible to overcome latent selection bias.*** Specifically,

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*Most of the work based upon the CNA retention models use civilian earnings measures derived from a simple human capital model originally used in O'Neil and Ross (1976). Some of the CNA models using these estimates are: Ross and Warner (1976), Warner (1978), Warner and Simon (1979), and Warner (1981).

**A recent study by Daula (1982) attempts to correct for this bias by using the Heckman adjustment factor. In fact, relatively few coefficients of the major variables were affected by this procedure.

***For a summary of recent selectivity bias issues, see: Barnow, Cain, and Goldberger (1980).

if the determinants of veteran earnings can be identified, then those determinants can be used to estimate opportunity wages. In this case it is assumed that the determinants of earnings -- not actual earnings -- are identical for veterans and active-duty personnel.

In the following section our procedure for estimating opportunity wages is discussed. Before embarking on that discussion, however, the salient policy concerns sould be highlighted. There are two basic concerns:

1. Are there significant differences in estimates of opportunity wages derived from various sources?

2. Do these differences have any significant bearing in our ability to explain and predict (re)enlistment behavior?

We will address these questions explicitly after describing our procedure for estimating opportunity wages on the basis fo veteran experiences.

Two-Stage Estimates

To assess the opportunity wages of Navy personnel, we have utilized a two-step estimation technique. The first step attempts to "explain" the observed wages of veterans on the basis of salient demographic, labor-market, and Naval-service characteristics. The "explanation" takes the form of a multivariate regression. The regression coefficients generated in this way are then used to estimate the opportunity wages of active-duty personnel. As noted above, the key assumption in this two-step procedure is that the determinants of earnings are identical for veterans and active-duty personnel.

B. *Step 1: The Wage Equations*

The first step in our development of opportunity wages requires observations of actual veteran earnings. This raises two immediate questions. First, which group of veterans is most relevant to the estimation problem.

Second, what measure of earnings is most appropriate.

The focus of this study is on the first re-enlistment decision of Navy personnel. Operationally, we have measured the outcomes of this decision by looking only at personnel who have completed at least 3 years of active duty. Continued service beyond four years is presumed to manifest a positive re-enlistment decision; personnel leaving the Navy during the third and fourth years are presumed to have declined re-enlistment. It is also assumed that enlistees who leave the Navy before completing 3 years of service have significantly different behaviorial characteristics than those who complete at least that much duty.* For these reasons, only the wages of those veterans with at least 3 years of active service, but less than 5 years, are deemed relevant to the estimation of opportunity wages at the time of the re-enlistment decision.

A total of 4,482 veterans in our sample have 3 or 4 years of service and observable post-Navy wages.** However, many of these veterans have very low wages, as Table 4.1 reveals. To a large but unknown extent these low wages may reflect part-time earnings of veterans attending school (on their GI benefits). Very low observed wages may also reflect secondary jobs, with uncovered employment (i.e., federal employment) being the primary job. In either case, the low end of the wage distribution described in Table 4.1 is likely to misrepresent veteran experiences. For this reason we have imposed a floor under wages. Only veterans with observable wages of at least $6,000

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* See Chapter 3 for further discussion.

** 446 veterans with 3-4 years of service had no observable wages in the first three post-Navy years. Most of these veterans probably entered federal employment which is not subject to Social Security taxes, while others were either unemployed, full-time students, or employed in other parts of the non-covered sector (e.g., selected state and local governments).

Table 4.1

Wages in the First Post-Navy Year
for Veterans with 3-4 Years of Service

Annual Wages (1982 dollars)	Percent of Veterans
0	17.9
$1-4,999	11.3
$5,000-$9,999	14.9
$10,000-$14,999	23.3
$15,000-$19,999	22.3
$20,000-$29,999	9.7
$30,000-$50,999	0.5
$51,000 or more	0.1
total	100.0
	(N=4,928)

Source: Job #191C

per year in the first year after leaving the Navy are included in this analysis. In effect, this floor requires something close to full-time employment at the legal minimum wage ($3.35 in 1982). A total of 3,365 veterans stisfy the service and post-Navy wage conditions of our sample. From this group we have chosen 1,000 veterans at random to implement the first step of our estimation procedure.

The second concern is to identify an appropriate measure of post-Navy wages. The basic question here is what measure of wages most influences retention decisions. Do enlistees base their re-enlistment decision on perceptions of wages immediately available? Or do they take a longer-run view of opportunity wages, including potential employment stability and wage growth?

For the purpose of this study, we have elected to use both short-run and long-run measures of opportunity wages. Since this study is exploratory, we want to determine which measure is more influential. Our short-run measure is the total earnings received in the first year after leaving the Navy. Our long-run measure encompasses three years of post-service earnings, discounted back to a present-value sum. In section D, we will seek to determine which of these measures has more impact on actual re-enlistment decisions.

1. Actual First-Year Wages

The average earnings of our selected veterans in their first post-service year were $14,749 (1982 dollars). Observed earnings ranged from $6,011 to $65,170,* with a standard deviation of $5,426. Table 4.2 shows

*The Social Security Administration arbitrarily sets estimated wages at $51,000 per employer for individuals who exceeded the taxable wage ceiling

the distribution of actual veteran wages in the first year after exit. Our objective here is to account for the evident variation in veteran wages, on the basis of available characteristics and experiences.

2. CPS and Leed Comparisons

The earnings reported in Table 4.2 refer to the actual experiences of veterans. These observations may be compared to other measures, particularly those based on Census data or the broad Social Security-covered workforce. The former comparison is particularly important since many empirical models of attrition have incorporated Census data as proxies for veteran earnings.* The comparison also provides perspective on the relative position of veterans in the civilian labor market.

Table 4.3 provides earnings comparisons for young men of varying work experience, from Social Security and Census data. The first three columns provide average annual earnings figures from Social Security (LEED) records. The first column refers to all males aged 20-24 who had any covered work experience in a given year. The second column includes only those workers who had earnings in each of the four calendar quarters. Naturally, these workers have higher eanrings on average than part-year workers. Finally, column (3) indicates the average earnings of the Navy veterans in our sample. As is evident, from 1965 onward, veterans had higher earnings than civilians of comparable age.**

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in the first quarter of a calendar year. Hence, an estimated wage of $65,170 indicates at least two jobs in a single year, one of which may have had wages in excess of the tax ceiling.

** See footnote above.

*** The average age at enlistment was 19 for our sample; the average age of the veteran subsample was 22.

Table 4.2

Wages in the First Post-Navy Year,
for Veterans with 3-4 Years of Service
and at least $6,000 of Civilian Wages

Annual Wages (1982 dollars)	Percent of Sample
$6,000-$9,999	18.1
$10,000-$14,999	34.1
$15,000-$19,999	32.7
$20,000-$29,999	14.2
$30,000-$50,999	0.7
$51,000 or more	0.2
total	100.0
	(N=3,365)

Source: Job #191B

Columns (4) and (5) provide earnings profiles from the annual Census surveys. Column (4) includes all males aged 20-24 with any work experience, and is thus comparable to column (1). In general, earnings averages for part-year workers based on Census data are slightly lower than comparable LEED averages. This probably reflects under-reporting of low-wage employment nominally subject to Social Security taxes. On other hand, Census data for year-round workers yield higher averages than LEED data. In part, this reflects the ceiling on Social Security taxable earnings. It also reflects the much more stringent definition of "year-round" (vs. 4-quarter) employment.

Two conclusions might be drawn from Table 4.3. First, Navy veterans enjoy high relative earnings, when assessed in the context of a common data base (LEED file). Second, observed LEED earnings may understate the true earnings of veterans because of the Social Security tax ceiling.

3. The First-Year Wage Regression

The foregoing comparisons, are intended to provide some perspective on the relative level of veteran wages. Our immediate objective remains, however, to explain the variation in observed veteran wages as documented in Social Security earnings records. To this end, we have regressed first-year civilian wages on available personal and experience characteristics.

Table 4.4 depicts the results of an OLS regression on veteran's wages in the first post-Navy year. The low multiple correlation coefficient ($\bar{R}^2$=.10) indicates that the available explanation of wages is very incomplete. Although this is not unusual for such micro-based wage models, it limits the ultimate utility of the resultant coefficients.

Observable personal characteristics (age and race) have a very minor impact on post-Navy wages for these short-service veterans. Age at

TABLE 4.3

Average Earnings of Males Aged 20-24
by Work Experience, and Data Source

	LEED			CENSUS	
YEAR	Civilian 1-4 quarter Workers (1)	Civilian 4 quarter Workers (2)	Navy veterans (3)	Civilian 1-4 quarter Workers (4)	Civilian Year-Round Workers (5)
1959	8,821.00	--	--	8,721.47	12,424.42
1960	8,958.62	11,559.16	10,696.00	8,254.43	12,867.98
1961	8,805.54	11,439.71	9,[illegible]3.00	8,633.46	13,158.39
1962	9,098.32	11,749.75	10,129.00	8,544.35	13,398.81
1963	9,372.96	12,023.65	10,916.00	8,467.17	13,443.99
1964	9,725.16	12,393.66	12,022.00	9,344.96	13,615.78
1965	10,191.30	12,915.79	13,265.00	9,344.23	14,518.01
1966	10,680.34	13,560.25	14,692.00	9,986.67	15,117.96
1967	10,508.58	13,468.67	15,259.00	9,820.63	15,484.48
1968	10,584.00	13,720.40	15,984.00	10,153.94	15,833.88
1969	10,775.32	13,956.06	16,623.00	9,990.77	16,378.70
1970	10,356.29	13,714.58	15,872.00	10,039.03	16,677.43
1971	10,100.65	13,746.36	15,137.00	9,929.19	16,037.62

TABLE 4.4

First-Year Wage
(N=1,000 Veterans with 3-4 years of service and post-Navy wages ≥ $6,000)

DEPENDENT VARIABLE	Mean Value (Standard Deviation)	Coefficient (Standard Error)
Annual Wage T+1	$14,749.78 (4,897.09)	N/A
INDEPENDENT VARIABLES		
A. Personal Characteristics:		
1. Age at Enlistment (years)	18.87 (1.72)	100.82 (580.79)
2. Squared Age (years)	358.99 (75.63)	2.62 (12.73)
3. Race (white=1)	0.94 (0.23)	303.80 (638.16)
4. North East (0,1)	0.21 (0.41)	629.83 (439.86)
5. Northcentral (0,1)	0.21 (0.41)	1,194.21* (438.96)
6. West (0,1)	0.12 (0.33)	-.003 (.030)
7. Unknown Region (0,1)	0.32 (0.47)	458.96 (725.19)
B. Navy Experience:		
8. Year of Enlistment (year)	61.73 (1.77)	111.12 (89.53)
9. Quarter of Enlistment (1-4)	2.47 (1.03)	-144.43 (162.22)
10. Initial Rank	1.89 (0.62)	865.53* (281.67)
11. Promotion Ratio	1.93 (1.18)	498.57* (154.04)

Table 4.4. First-Year Wage Regression (cont'd)

	Mean Value (Standard Deviation)	Coefficient (Standard Error)
C. Pre-Service Experience		
12. Total Quarters of Experience	3.72 (3.23)	-185.38* (80.30)
13. Total Full-Time Experience (quarters)	1.06 (2.01)	367.66* (162.12)
14. Pre-enlistment Wage	2,413.55 (3,401.37)	0.22* (0.10)
15. Agriculture	0.04 (0.20)	1,031.62 (944.32)
16. Mining	0.01 (0.08)	425.86 (1,985.00)
17. Construction	-- --	-- --
18. Manufacturing: Nondurable	0.06 (0.24)	1,330.21 (806.53)
19. Manufacturing: Durable	0.07 (0.26)	-103.12 (813.15)
20. Transportation & Utilities	0.02 (0.15)	-708.00 (1,149.59)
21. Wholesale/Retail Trade	0.31 (0.46)	384.23 (637.25)
22. Finance & Real Estate	0.01 (0.11)	-2,219.26 (1,469.82)
23. Business Services	0.06 (0.23)	498.92 (846.13)
24. Personal Services	0.03 (0.16)	-55.23 (1,081.44)
25. Government	0.01 (0.11)	-72.05 (1,399.71)
D. Other		
26. Unemployment Rate (T+1)	5.68 (1.35)	-469.44* (113.61)
27. Constant		4,203.98
$\bar{R}^2$ = .10		

Source: Job #196 (N=1000)

*Significant at .10 level (one-tail).

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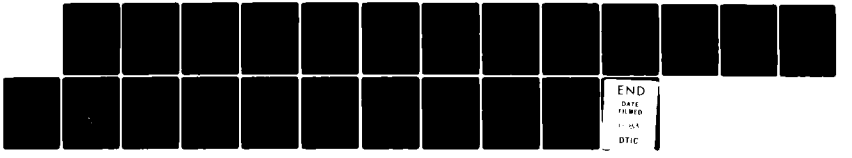

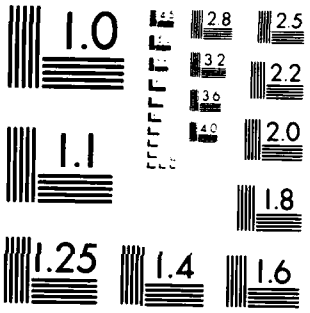

enlistment (variables 1 and 2) has a positive impact, even after controlling for preenlistment work experience. Race (variable 38) has the expected positive sign, but does not achieve statistical significance. Regional origin does appear to have some influence, as indicated by the large and statistically significant coefficient for Northcentral. Ostensibly, this coefficient implies that enlistees from Northcentral states command much higher wages (+$1,194) than enlistees from the South (the suppressed variable). However, regional origins are known only for those enlistees who held a civilian job prior to enlistment (68 percent of the sample). Hence, the "regional" coefficients reflect a combination of geographic and work-experience influences. They should be interpreted to mean that an enlistee from the Northcentral who worked commanded higher post-service wages than an enlistee from the South who also worked prior to enlistment.

Observable Navy variables appear to have more influence on veteran wages. First rank (variable 10) is particularly important: enlistees who reach a higher rank in the first year command significantly higher post-service wages. Specifically, a veteran whose first rank was E3 commanded $1,730 more post-Navy wages than a veteran whose first rank was identified as a "raw" (E1) recruit. Once again, this relation stands even after controlling for pre-enlistment work experience and personal characteristics. This suggests that personnel obtaining higher initial ranks -- including prior service and non-prior service lateral entrants -- do infact possess superior earnings capabilities.

Also noteworthy is the relation of in-service promotion to post-service wages. Veterans who were promoted more rapidly during their first three years of Navy service also command higher civilian wages. This suggests similar

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* Similar regional effect for Army re-enlistees has been bound by Daula (1982).

determinants of both Naval and civilian job success.

Additional regressions were run with length of service as an additional independent variable. As expected, length of service (in quarters) had a positive and highly significant impact on post-service wages, even within the narrow range of 3-4 years. However, length of service cannot be used as a predictive variable for re-enlistment, since it is the characteristic to be predicted.* Since the whole purpose of the wage model is to estimate opportunity wages and, ultimately, re-enlistment probabilities, length of service was excluded from the model.

The other determinants of first-year veterans' earnings relate to pre-Navy work experience. Veterans with more substantial pre-service work experience command significantly higher post-service earnings. This relationship is reflected in the coefficients for the following variables: total quarters of experience in the two years prior to enlistment (variable 12), total full-time experience (variable 13) and pre-enlistment wages (variable 14). The three variables together suggest that minimal, low-wage work experience has no meaningful effect on post-Navy wages. On the other hand, full-time work experience, especially at higher wages, does appear to have a permanent, positive effect on wages.

The links between pre-service job experience and post-service wages may reflect two different phenomena. On the one hand, greater work experience implies more skill development. On the other hand, work experience also implies more knowledge of job opportunities, and thus a more optimal work decision.

Variables 15-25 indicate the industry affiliation of enlistees prior to Navy service. The affiliation reflects the industry of the employer from

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*It may be noted that some recent studies have used a measure of length of service as an explanatory variable. See for example Warner (1979-b).

whom the most wages were received in the year prior to enlistment. For enlistees without prior work experience, no industry affiliation is available. These observations were suppressed. Hence, the coefficients reflected in Section C indicate the value of having worked in a specific industry, as compared to not working at all. For example, an enlistee with agriculture experience (variable 15) generally will earn $1,032 more after leaving the Navy than a veteran with no prior work experience. By comparing coefficients across different industries, the relative value of different industry affiliations can be assessed. This procedure reveals, for example, that agriculture and nondurable manufacturing experience yield superior post-Navy wages, while durable manufacturing, transportation/utility, and real estate/finance experience is associated with lower post-service earnings. None of the industry coefficients are statistically significant, however.

Variable 26 gauges the unemployment rate in the first year after leaving the Navy. Higher unemployment in the civilian economy tends to reduce veteran wages sharply. Specifically, each 1-percent increase in the unemployment rate lowers expected veteran wages by $469 per year. This is the most statistically significant determinant of veteran wages.

4. Three-Year Wage Streams

Our second measure of veteran wages encompasses a longer-run perspective. Specifically, the first three years of post-service earnings are included. The resulting earnings stream is then discounted to the time of termination, thereby yielding a single (present) value. This value is then used to represent longer-term opportunity wages.

To perform the analysis of longer-term opportunity wages, the sample is restricted to veterans with 3-4 years of service and three consecutive years

of observable post-Navy wages in excess of $6,000 per year. A total of 2,179 veterans satisfied these conditions. From this sample 1,000 records have been chosen at random to estimate the regression of present-value wages.

In principle, the choice of the interest rate to discount future earnings could have a material impact on retention decisions. Higher discount rates reduce the economic value of future wage growth. Since military wage structures offer less latitude for wage growth than civilian wage structures, higher discount rates will tend to render opportunity wages of Navy personnel less attractive. That is to say, the possiblities for superior wage growth in civilian jobs tend to be neutralized by higher discount rates. Higher discount rates also reduce the variance in long-term wages among veterans.

Recent evidence suggests that military personnel do in fact have very high subjective discount rates.* This suggests that wage growth possibilities in civilian sector are not seriously evaluated by Navy personnel making a re-enlistment decision. Instead, immediate wage opportunities dominate the decision.

To examine this issue more closely, we have used three different (real) interest rates (3, 10, 20) to discount future earnings. Only the results using the 10 percent rate are presented here, since the other two rates yielded comparable results.

The average three year discounted wage stream for those with positive earnings in each of the three post-Navy years was $43,232 (1982 dollars), with observed wage streams varying from under $2,000 to $72,975. The results of the OLS model used to explain this variance is shown in Table 4.5. As is apparent from the statistical fit ($\bar{R}^2 = .12$), the discounted wage model is no more convincing than the first-year wage model.

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*See for example: Gilman (1976) and Cylke, et. al. (1982).

TABLE 4.5

Present-Value Wage Regression
(N=1,000 Veterans with 3-4 years of service and wages ≥ $6,000
in each of first three post-Navy years)

DEPENDENT VARIABLE	Mean Value (Standard Deviation)	Coefficient (Standard Error)
Present Value of Three-Year Wage Stream (@10%)	$43,231 (11,628)	N/A
INDEPENDENT VARIABLES		
A. Personal Characteristics:		
1. Age at Enlistment (years)	18.9 (1.8)	1,123.41 (1,441.49)
2. Squared Age (years)	358.7 (81.0)	-24.42 (31.03)
3. Race (white=1)	0.95 (0.21)	-2,403.47 (1,757.28)
4. North East (0,1)	0.19 (0.39)	3,807.29* (1,258.51)
5. Northcentral (0,1)	0.26 (0.44)	1,450.79 (1,193.93)
6. West (0,1)	0.10 (0.30)	1,066.15 (1,487.44)
7. Unknown Region (0,1)	0.32 (0.46)	-2,314.11 (2,020.91)
B. Navy Experience:		
8. Year of Enlistment (year)	61.1 (1.5)	36.40 (282.03)
9. Quarter of Enlistment (1-4)	2.41 (1.05)	-772.28* (378.40)
10. Initial Rank	1.90 (0.58)	3,007.35* (747.21)
11. Promotion Ratio	2.04 (1.25)	2,421.88* (362.91)

Table 4.5. (cont'd)

C. Pre-Service Experience	Mean Value (Standard Deviation)	Coefficient (Standard Error)
12. Total Quarters of Experience	3.62 (3.22)	288.49 (190.78)
13. Total Full-Time Experience (quarters)	1.00 (2.10)	49.52 (372.95)
14. Pre-enlistment Wage	2,382.17 (3,493.74)	0.64* (0.24)
15. Agriculture	0.04 (0.18)	-1,413.27 (2,417.67)
16. Mining	0.01 (0.08)	-8,123.86 (4,453.25)
17. Construction	———	———
18. Manufacturing: Nondurable	0.07 (0.26)	-5,782.40* (1,994.27)
19. Manufacturing: Durable	0.06 (0.24)	-4,959.58* (2,086.47)
20. Transportation & Utilities	0.03 (0.16)	-7,763.16* (2,691.81)
21. Wholesale/Retail Trade	0.33 (0.47)	-4,857.21* (1,671.46)
22. Finance & Real Estate	0.01 (0.11)	-8,138.07* (3,434.54)
23. Business Services	0.06 (0.23)	-4,872.94* (2,147.88)
24. Personal Services	0.03 (0.16)	-5,303.65* (2,688.78)
25. Government	0.01 (0.09)	-1,849.57 (3,966.93)
D. Other		
26. Unemployment Rate (T+1)	5.65 (1.31)	-679.30* (322.43)
27. Constant		25,992.93
$\bar{R}^2$ = .12		

Source: Job #198 (N=1000)

*Significant at .10 level (one tail)

Once again, personal attributes are not significantly related to this post-Navy earnings measure and the only personable variable that is statistically significant is the Northeast (variable 4) which indicates pre-Navy employment in the Northeast relative to being employed in the South. A premium of $3,807 is realized by such individuals as compared with working in the South.

Perhaps the most dramatic difference between the post-Navy wage and discounted wage stream model lies in the significance of the pre-Navy civilian work experience variables. Two basic measures of pre-enlistment work experience (variable 12 and 13) that were significant correlates of first-year wages lost significance and one changed sign in the present-value model. The industry-affiliation variables generally gained in significance, however, which offset these reversals.

The Navy variables also undergo change in this model. Initial rank grows in size and significance, as does the rate of promotion. This strengthens the earlier suggestion that the determinants of rank and promotion are similar in both Navy and civilian jobs.

Finally, it may be noted that unemployment in the year following exit from the Navy appears to have a lasting impact on post-service wages. Each percentage point in unemployment lowers the discounted wage stream by $679 as compared to its immediate impact of $469 on the wages in the year following exit.

C. Step 2: Estimated Opportunity Wages

The foregoing sections have described our multivariate explanations of observed veteran wages. The second step in our wage analysis entails the estimation of opportunity wages for Navy personnel still in active service. To make these estimates, we apply the regression coefficients of the wage

model(s) to the characteristics of individuals. In this way, we are assuming that the determinants of wages for active personnel are identical to those of veterans.

The wage models described above were apllied to all personnel (including veterans) with at least three years of service. Hence, we estimate wages not only for active-duty personnel without observable civilian earnings, but also for veterans who have civilian jobs. This procedure helps overcome selection bias in our retention model. It also permits us to determine how well estimated wages match actual wages for veterans.

1. Estimated Fourth-Year Wages

Our first estimates for opportunity wages relate to the fourth year of (potential) service. To make these estimates we use the regression coefficients reported in Table 4.4. These coefficients are then applied to all enlistees with at least three years of service. In effect, then, we are estimating annual opportunity wages at the approximate time of the re-enlistment decision.*

The average estimated opportunity wage for the 5,812 enlistees in our sample is $15,861. Naturally, this is quite close to the average actual wage of veterans ($13,050), since the wage model is based on veteran experiences.

Our sample of 5,812 enlistees with at least three years of service includes both (1) those who leave before completing five years of service, and (2) those who complete at least 5 years of service. It is of some interest to calculate the estimated opportunity wage for these two groups at the time of the re-enlistment decision. This computation reveals that re-enlistees

*Recall that the wage model itself is estimated on the basis of observed wages of veterans with 3-4 years of Navy service.

TABLE 4.6

Characteristics of Leavers and Stayers
Affecting Opportunity Wages

ESTIMATED OPPORTUNITY WAGE	Regression Effect on Fourth-Year Wages	Leavers	Stayers
INDEPENDENT VARIABLES			
A. Personal Characteristics:			
1. Age at Enlistment (years)	+	19.0	19.4
2. Squared Age (years)	+	364.3	389.4
3. Race (white=1)	+	0.9	0.9
4. North East (0,1)	+	0.185	0.145
5. Northcentral (0,1)	+*	0.229	0.160
6. West (0,1)	-	0.136	0.155
7. Unknown Region (0,1)	+	0.289	0.377
B. Navy Experience:			
8. Year of Enlistment (year)	+	62.7	61.7
9. Quarter of Enlistment (1-4)	-	2.5	2.3
10. Initial Rank	+*	1.95	1.96
11. Promotion Ratio	+*	1.6	2.7

Table 4.6. Characteristics of Stayers and Leavers

	Regression Effect on Wages	Leavers	Stayers
C. Pre-Service Experience			
12. Total Quarters of Experience	-*	4.0	3.1
13. Total Full-Time Experience (quarters)	+*	1.3	0.8
14. Pre-enlistment Wage	+*	2694	
15. Agriculture	+	0.034	0.027
16. Mining	+	0.006	0.007
17. Construction	+	0.053	0.050
18. Manufacturing: Nondurable	+	0.075	0.055
19. Manufacturing: Durable	-	0.079	0.052
20. Transportation & Utilities	-	0.022	0.023
21. Wholesale/Retail Trade	+	0.321	0.270
22. Finance & Real Estate	-	0.013	0.014
23. Business Services	+	0.065	0.079
24. Personal Services	-	0.023	0.021
25. Government	-	0.018	0.023
D. Other			
26. Unemployment Rate (T+1)	-*	6.2	6.1
27. Constant			
$\bar{R}^2$ = .08			

Source: Job #188 (N=4,928); Job #187 (N=884)

*Significant at .10 level (one tail).

had lower opportunity wages ($14,510) than enlistees who left the Navy at this juncture ($16,103). This observation is consistent with general expectations about the relationship of opportunity wages to retention.

The higher opportunity-wage estimates for "leavers" result from higher values of leavers for the variables in the wage model. Table 4.6 displays the mean values for each of the variables in the wage model, for both re-enlistees (stayers) and enlisted personnel who elect not to re-enlist (leavers). Also shown is the general effect (sign) of each variable on estimated wages. Notice, for example, that leavers were more likely to come from the Northeast or North-central regions, both of which are associated with higher wages. By contrast, stayers are more likely to come from the West or South, both of which tend to reduce opportunity wages. Leavers also earned higher wages before enlisting in the Navy, a phenomenon which not only raised their opportunity wages but may have increased their "taste" for civilian jobs as well.

Although Table 4.6 provides some clues as to why leavers have higher opportunity wages than stayers, the entire exercise must be interpreted with great caution. As already noted, the explanatory power of the wage model is very low. Because of this, the variance of estimated wages is quite high.

2. Estimated vs. Actual Wages

The low explanatory power of the wage model also manifests itself in high error rates for predicted wages. The wage model was estimated on only 1,000 leavers who were chosen at random from the 3,365 veterans who satisfied our sample conditions. This left 2,365 leavers in the sample who had observable wages in excess of $6,000 but were not included in the wage-model derivation. To determine the predictive power of the wage equation, actual and predicted wages were derived from a subsample of 200 observations chosen at random from the 2,365 leavers not included in the wage model. Given the low explanatory

power of the wage models (above), it is not surprising that predicted and actual wages differ substantially. The correlation coefficient between actual and predicted wages for this sub-sample was 0.06, and was not statistically significant.*

Figure 4.1 illustrates the discrepancy between actual and predicted wages. There is a clear tendency for wages to be overestimated at lower wages and underestimated at higher levels. In essence, the wage model does not explain much of the deviation about the mean ($14,987 for this sub-sample). As seen in Figure 4.1 nearly all predicted values lie above the Line of Perfect Fit (LPF) for actual wages in excess of the mean. For example, observation point labeled "A" represents a predicted value of $13,000 given the actual value of $23,000. The $10,000 difference is due to random factor and excluded non-random factors in the wage model. This underestimation characterizes above mean actual wages, as only twenty predicted values exceed actual wages in excess of the $15,000 mean value. (See shaded area in Figure 4.1.)

Similarly, the model under-predicts only seven values of actual wages below the mean. The resulting pattern of errors is shown more clearly in Figure 4.2. Large negative errors (i.e., actual less predicted) characterize predicted values below the mean, and become progressively larger the farther from the mean. Large positive errors characterize predicted values above the mean and become progressively larger the farther from the mean.

Additional in-service information along with personal data such as family status, mental ability, and education will become available in the second phase of this study. These factors should increase the predictive power of the wage models substantially.

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*The root mean squared error (RMSE) for this subsample was $5,797, with 82.9% of the error due to residual factors, and only 5.4% due to bias and 11.7% due to the slope error. For further discussion on the decomposition of the error variance, see: Theil (1964).

FIGURE 4.1

Actual vs. Predicted Wages of Full-Time Veterans in Covered Employment

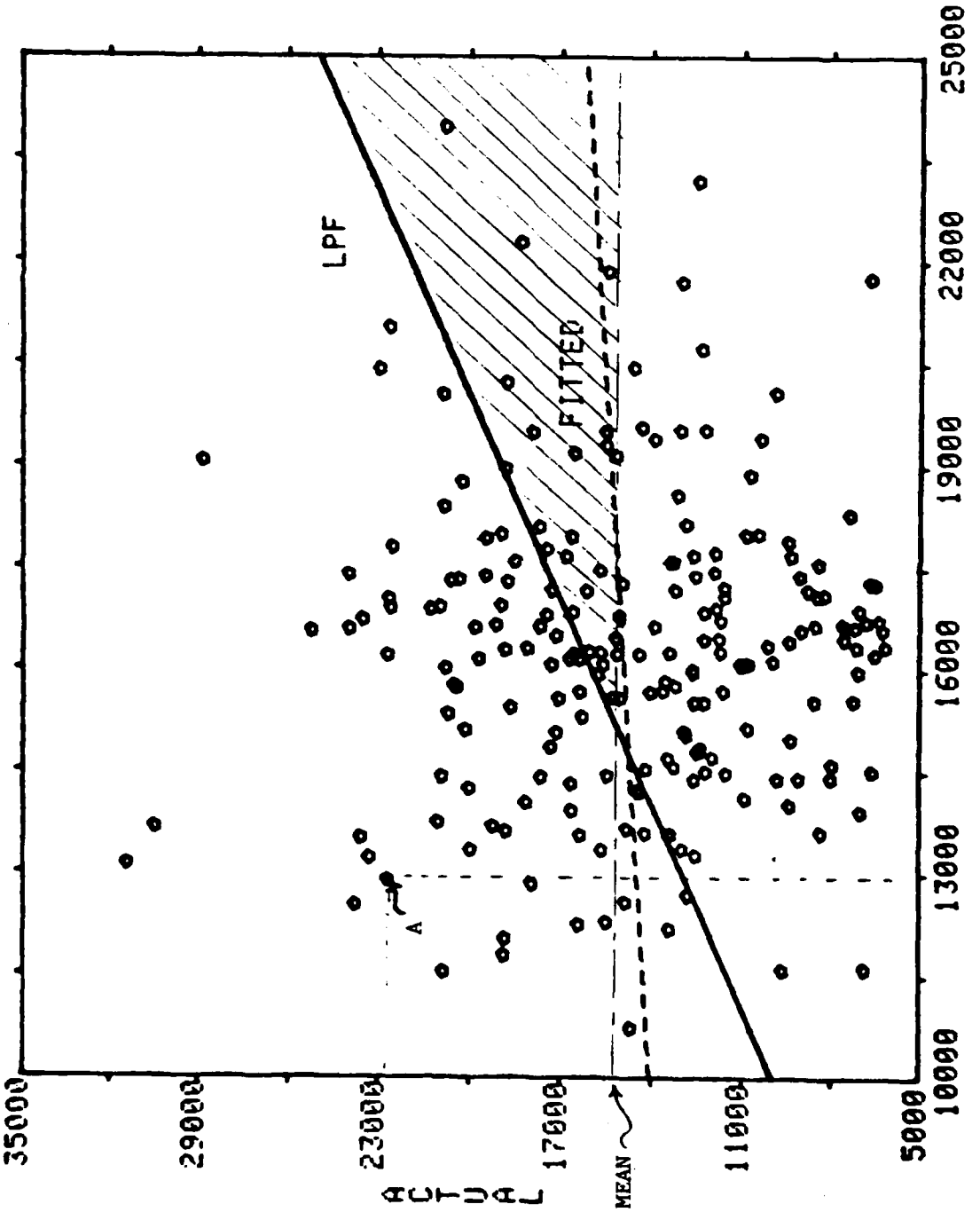
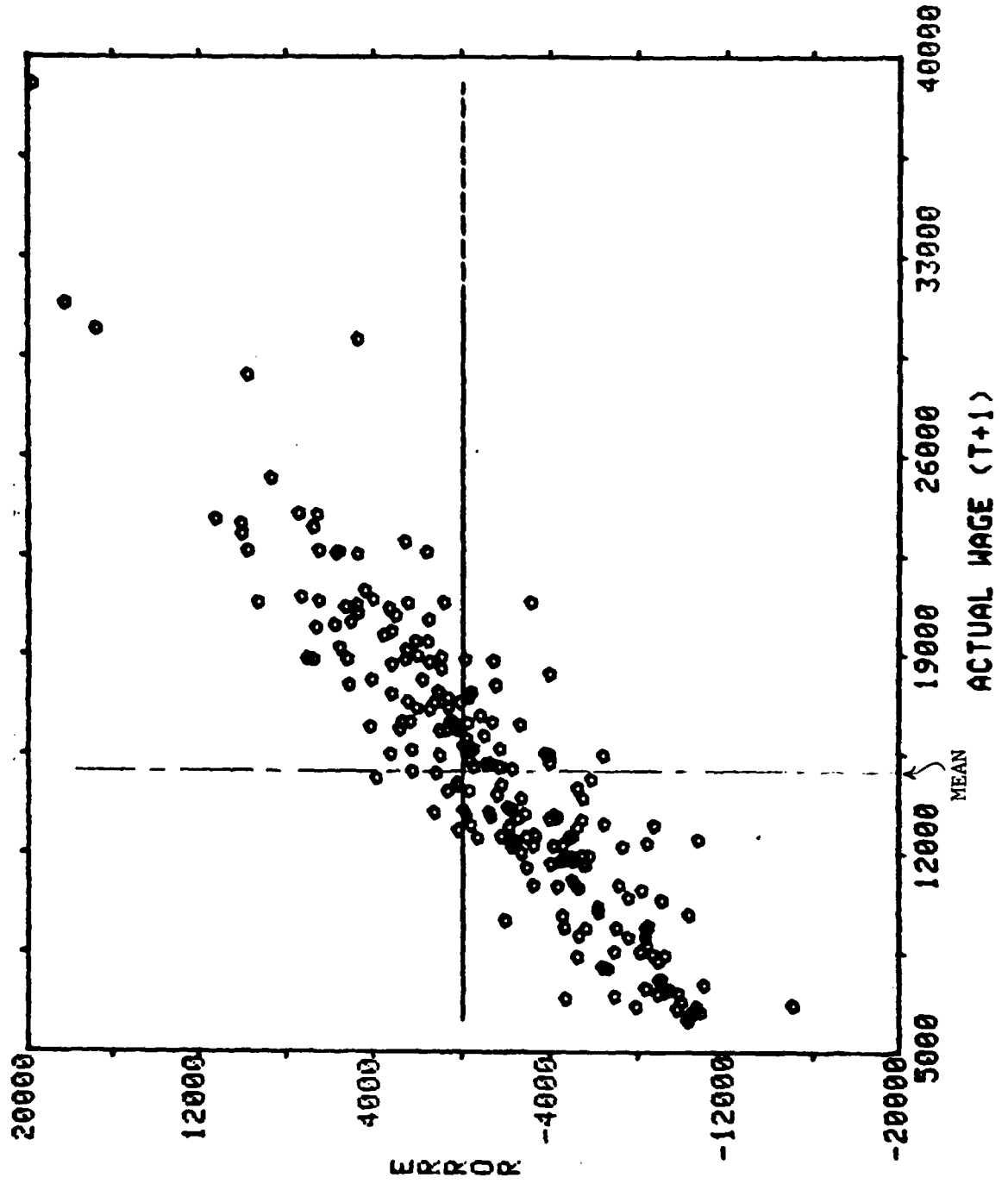


FIGURE 4.2

Pattern of Wage Model Errors for Full-Time Veterans in Covered Employment



D. Step 3: Opportunity Wages and Re-Enlistment

The primary objective of this study is to determine the extent to which opporunity wages and other economic influences affect re-enlistment decisions. As is evident, this phase of the study is not capable of providing a definitive answer to that question. The constraints of this study include: (1) draft-era constraints on decision-making, (2) inadequate information on personal characteristics and in-service experience, and (3) low predictive power of the wage model. Hopefully, all of these constraints will be relieved in the second phase of the study.

Despite present constraints, the question of how opportunity wages affect re-enlistment can be pursued. In so doing, two objectives are served. First, the methodological approach can be tested and refined. Second, some preliminary perspectives on re-enlistment behavior can be developed.

As noted above, the simple (two-dimensional) correlation between opportunity wages and re-enlistment is negative. That is to say, enlistees with better wage-related characteristics appear less likely to re-enlist. The question posed here is whether this observation holds up in a multivariate context. The question is answered by estimating a multiple regression of re-enlistment on available characteristics, including estimated opportunity wages.

The entire sample of 5,812 enlistees with at least three years of service is used in this procedure. The independent variable is dichotomous, indicating whether the individual stayed at least two more years. Hence, we are looking at conditional probabilities of staying five years, having served three already. Fifteen percent of the sample remained in the Navy at least 5 years and are assumed to have re-enlisted. Our regression analysis seeks to identify distinguishable characteristics of those re-enlistees. In this

context, the coefficients of the independent variables can be interpreted as partial changes in the conditional probability of re-enlistment.

1. Immediate Opportunity Wages

Table 4.7 summarizes the regression estimates for the retention model.* Overall, the model does a very modest job ($\bar{R}^2 = .16$) of accounting for re-enlistment patterns. The most significant behaviorial variables are related to rank. Specifically, both initial rank (variable 10) and the rate of promotion (variable 11) are positively and significantly correlated with re-enlistment. Specifically, a lateral entrant at rank E3 has a .12 higher conditional probability of re-enlisting than the average "raw" enlistee (E1). Similarly, personnel who move up the enlisted ranks more quickly are significantly more likely to re-enlist. These relationships may reflect both economic and personnel-management factors. Higher rank and faster promotion may reduce the relative value of civilian opportunity wages. Rank and promotion may also manifest a greater commitment to ("taste" for) Naval service as well as management recognition of that commitment.

Work experience and opportunity variables do not have much apparent effect on the re-enlistment decision. Only one of the pre-service characteristics (variable 12) is significantly related to the conditional probability of re-enlistment. Likewise, estimated opportunity wages at the time of the re-enlistment decision (variable 26) fail to attain statistical significance, although they do manifest the expected negative sign. The only standout

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*The estimates were generated by ordinary least squares (OLS). Despite the theoretical superiority of explicitly probabilistic transformations (e.g., probit), empirical results with OLS are comparable, especially for large samples.

TABLE 4.7

Determinants of Re-Enlistment
for Personnel with Three Years of Service

DEPENDENT VARIABLE	Mean Value (Standard Deviation)	Coefficient (Standard Error)
Conditional Probability of Re-Enlistment	0.15 (0.36)	N/A
INDEPENDENT VARIABLES		
A. Personal Characteristics:		
1. Age at Enlistment (years)	19.07 (2.12)	.007 (.007)
2. Squared Age (years)	368.15 (125.13)	.000 (.000)
3. Race (white=1)	.93 (.26)	-.103* (.018)
4. North East (0,1)	.18 (.38)	-.012 (.017)
5. Northcentral (0,1)	.22 (.41)	-.120 (.019)
6. West (0,1)	.14 (.35)	.022 (.016)
7. Unknown Region (0,1)	.30 (.46)	.005 (.017)
B. Navy Experience:		
8. Year of Enlistment (year)	62.55 (2.31)	-.024* (.002)
9. Quarter of Enlistment (1-4)	2.44 (1.06)	-.026* (.005)
10. Initial Rank	1.95 (.83)	.063* (.012)
11. Promotion Ratio	2.05 (1.23)	.040* (.012)

Table 4.7 (cont'd)

	Mean Value (Standard Deviation)	Coefficient (Standard Error)
C. Pre-Service Experience		
12. Total Quarters of Experience	3.84 (3.29)	-.007* (.003)
13. Total Full-Time Experience (quarters)	1.21 (2.22)	.002 (.007)
14. Pre-enlistment Wage	2580.26 (3675.23)	.001 --
15. Agriculture	.033 (.18)	-.030 (.026)
16. Mining	.006 (.08)	$-.9^{-04}$ --
17. Construction	.05 (.22)	-.010 (.021)
18. Manufacturing: Nondurable	.07 (.26)	$-.31^{-03}$ (---)
19. Manufacturing: Durable	.07 (.26)	-.235 (.018)
20. Transportation & Utilities	.02 (.15)	-.004 (.033)
21. Wholesale/Retail Trade	.313 (.46)	$-.59^{-03}$ --
22. Finance & Real Estate	.013 (.11)	-.019 (.048)
23. Business Services	.067 (.25)	.028 (.018)
24. Personal Services	.023 (.15)	-.012 (.030)
25. Government	.019 (.14)	-.001 (---)
D. Other		
26. Opportunity Wage	15860.88 (2354.53)	$-.119^{-04}$ $(.1^{-04})$
27. Unemployment Rate	3.70 (3.23)	.029* (.005)
28. Constant		1.511
$\bar{R}^2 = .16$		

Source: Job #197 (N=5,812)

*Significant at .10 level (one tail).

of the economic variables is the civilian unemployment rate (variable 27). Higher unemployment rates in the civilian labor market do deter attrition. Every 1-point increase in the civilian unemployment rate raises the conditional probability of re-enlistment by .03.

2. Opportunity Wage Streams

Our second conditional re-enlistment model incorporates a longer-run view of civilian opportunities. In this model, the present discounted value of a three-year wage stream is used rather than an estimate of immediate (first-year) opportunity wages. The basis for the wage-stream estimates was described in Section B.4 and the empirical model summarized in Table 4.5.

Table 4.8 summarizes the results of this second variant of the conditional re-enlistment model. The results are very similar to the former model, both in terms of overall fit ($\bar{R}^2$ = .16) and specific coefficients. Unfortunately, this similarity also applies to the opportunity wage measure. The present discounted value of the estimated civilian wage stream does not have a significant impact on the re-enlistment decision. Moreover, it's apparent sign is positive, which contradicts theoretical expectations.

TABLE 4.8

Determinants of Conditional Re-enlistment, Probability,
Including Discounted Opportunity Wage Stream

DEPENDENT VARIABLE	Mean Value (Standard Deviation)	Coefficient (Standard Error)
Conditional Probability of Re-Enlistment	0.15 (0.36)	N/A
INDEPENDENT VARIABLES		
A. Personal Characteristics:		
1. Age at Enlistment (years)	19.07 (2.12)	.005 .010
2. Squared Age (years)	368.15 (125.13)	.001 (.000)
3. Race (white=1)	.93 (.26)	-.105* (.023)
4. North East (0,1)	.18 (.38)	-.023 (.029)
5. Northcentral (0,1)	.22 (.41)	-.028 (.017)
6. West (0,1)	.14 (.35)	.021 (.018)
7. Unknown Region (0,1)	.30 (.46)	.012 (.036)
B. Navy Experience:		
8. Year of Enlistment (year)	62.55 (2.31)	-.025* (.002)
9. Quarter of Enlistment (1-4)	2.44 (1.06)	-.023* (.007)
10. Initial Rank	1.95 (.63)	.050* (.021)
11. Promotion Ratio	2.05 (1.23)	.032* (.016)

Table 4.8 (cont'd)

	Mean Value (Standard Deviation)	Coefficient (Standard Error)
C. Pre-Service Experience		
12. Total Quarters of Experience	3.84 (3.29)	-.004 (.003)
13. Total Full-Time Experience (quarters)	1.21 (2.22)	.002 (.004)
14. Pre-enlistment Wage	2580.26 (3675.23)	$-.29^{-05}$ (.000)
15. Agriculture	.033 (.18)	-.055 (.045)
16. Mining	.006 (.08)	-.011 (.062)
17. Construction	.05 (.22)	-.024 (.050)
18. Manufacturing: Nondurable	.07 (.26)	-.024 (.026)
19. Manufacturing: Durable	.075 (.26)	-.031 (.028)
20. Transportation & Utilities	.02 (.15)	-.001 --
21. Wholesale/Retail Trade	.31 (.46)	-.014 (.024)
22. Finance & Real Estate	.01 (.11)	.001 --
23. Business Services	.07 (.25)	.013 (.029)
24. Personal Services	.02 (.15)	-.020 (.036)
25. Government	.02 (.14)	-.014 (.047)
D. Other		
26. Opportunity Wage Stream	42,639.97 (5,091.21)	$.999^{-06}$ $(.1^{-04})$
27. Unemployment Rate (T+1)	3.70 (3.23)	.035* (.005)
28. Constant		1.45
$\bar{R}^2 = .16$		

Source: Job #199 (N= 5812)

*Significant at .10 level (one tailed).

E. Summary

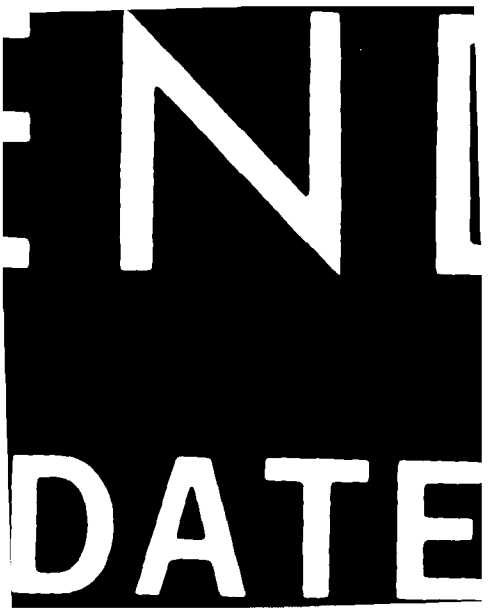
Navy veterans enjoy relatively high civilian wages. However, there is substantial variation in these wages.

The variation in veteran wages is only partially attributable to basic demographic, in-service, and pre-service work experience characteristics. The data available explain only 10-12 percent of observed differences in immediate or larger term post-Navy wages.

The low accountability of the available wage model renders opportunity-wage estimates of limited value. The correlation between actual and predicted wages is extremely low, within the context of the present model.

Despite the low reliability of predicted wages, they do have a significant correlation with re-enlistment. Specifically, personnel who have higher predicted opportunity wages are less likely to re-enlist, as hypothesized in most re-enlistment models. On the other hand, higher initial rank, faster in-service promotion, and higher civilian opportunity wages all encourage re-enlistment among personnel with three years of service.

All of the findings discussed in this chapter are based on a very rudimentary data base. Subsequent data enhancement may alter specific findings.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